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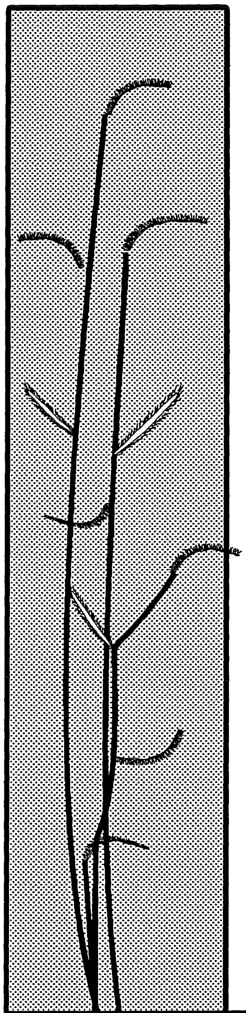

Rangeland
Analysis And Management Training Guide

RANGELAND
ANALYSIS AND MANAGEMENT
TRAINING GUIDE

ROCKY MOUNTAIN REGION
U.S. FOREST SERVICE

August 1996

United States Department of Agriculture
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Reply to: 2200 Rangeland Management

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Subject: Rangeland Analysis and Management Training Guide

To: Forest Supervisors

Rangelands are valuable and extensive ecosystems in the Rocky Mountain Region. They comprise about 50 percent of the Region's total land area. Rangelands provide clean water, forage for grazing and browsing animals, cover for many wildlife species, and a variety of recreational opportunities for our visitors. Rangelands are of vital economic importance to the many rural communities throughout our five state area.

As we continue our focus on ecosystem management, rangelands will play a critical role. I hope each of you will look at rangelands at a broader perspective, focusing on sustainable natural processes that provide healthy ecosystems for the needs and values of a diverse American public.

The revision of this Guide is an important step in continuing the analysis and management processes we began in 1994. There has been a tremendous amount of energy and expertise put into the development and improvement of this Guide from personnel within the Forest Service, other agencies, research, and universities. I would like to thank all those that contributed to this effort. The quality of the Guide is a testimony to those who have used it and suggested improvements, and to the countless hours spent in producing it.

Elizabeth Estill

ELIZABETH ESTILL
Regional Forester

Enclosure

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OVERVIEW

INTRODUCTION

Rangelands are a major component of ecosystems in the western United States. They are lands that include strong representation by herbaceous and graminoid species. Rangelands include, but are not limited to: grasslands, forblands, shrublands, open-canopied forests, and associated riparian and aquatic areas. Well-managed rangelands provide forage and cover for wildlife and for domestic livestock, in addition to high quality water and numerous recreational values.

OBJECTIVES

Rangeland analysis is essential for planning Forest Service management activities. This guide provides instructions and standards for conducting rangeland analysis and management. Rangeland analysis information is used to prepare and maintain Forest Land and Resource Management Plans and project level plans (for example, allotment management plans). Rangeland analysis uses a systematic procedure of collecting, recording, and evaluating data. It also provides permittees, Forest Service officers, cooperating agencies, and the public an opportunity for mutual appraisal of rangelands. The intensity of studies conducted on rangelands will vary dependent on the need for information, and land management and allotment objectives.

DIRECTION

Instructions in this guide are supported by direction and guidelines in other documents, including: the Forest Service Manual;[1] the Service-wide Range Analysis and Management Handbook;[2] the Ecosystem Classification, Interpretation, and Application Handbook;[3] and the Integrated Resource Inventory Training Guide (U.S. Forest Service, 1995). Individuals performing rangeland analysis should be familiar with direction in these documents before starting any analysis project.

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[1] FSM 2210 and FSM 2060

[2] FSH 2209.14

[3] FSH 2090.11

GENERAL INSTRUCTIONS

Rangeland analysis addresses the systematic collection and evaluation of rangeland resource data. Existing vegetation (plant community) and desired vegetation is mapped and inventoried. Within these map units, plant species, land capable of supporting livestock grazing, and desired condition status of the rangeland are identified. Analysis provides a baseline for determining resource value ratings, and for periodic measurement of rangeland condition, leading to trend determinations.

The National Forest Management Act of 1976 and its implementing regulations identifies information requirements concerning National Forest System grazing resources. This information is collected through rangeland analysis and/or allotment management planning. The requirements are:

- Identify capability of National Forest System lands for producing forage for grazing animals and for providing habitat for management indicator species.
- Determine and monitor status and trend of capable rangelands.
- Determine present and potential supply of forage for livestock and wild free-roaming horses and burros, and estimated capability of these lands to produce suitable food and cover for selected wildlife species.
- Estimate forage use by grazing and browsing animals.
- Identify lands in less than satisfactory condition and prescribe the appropriate action for their restoration.
- Develop rangeland management prescription alternatives that provide for the maintenance and evaluation of soil, water, and air quality resources. Give consideration to:
  - grazing systems and facilities necessary to implement the prescription;
  - land treatment and vegetation manipulation practices;
  - evaluation of pest problems;
  - possible conflicts or beneficial interactions among livestock, wild free-roaming horses and burros, and wild animal populations, and methods to regulate them;
  - direction for rehabilitating ranges in unsatisfactory condition; and
  - comparative cost efficiency of prescriptions.

Rangeland analysis will meet or exceed these information requirements. The one possible exception is with respect to wildlife species (see page 2-3). Those species and their habitat requirements should be identified and evaluated as an integral part of rangeland analysis and allotment management planning. Where habitat requirements of plant and animal species are not fully understood, rangeland managers should continue with project planning and implementation using the best information available from wildlife and botany specialists. Range plans should include schedules for completing surveys and research to provide an appropriate level of information on threatened, endangered, and sensitive (TES) species and habitat. Project plans can be modified as the additional information becomes available.

ECOLOGICAL CLASSIFICATION

An ecological classification is the integration of landform, topography, geology, soil, vegetation, climate, and other characteristics into products useful to managers.[4] Products include guides and other tools. Data obtained through rangeland inventory and analysis will supplement that used to develop ecological type classifications.

GUIDES

An ecological guide presents quantitative and qualitative information on ecological classification taxa, for example, landtypes, plant associations, and community types. They may relate to either potential natural vegetation or to existing vegetation.

Physical, topographical, and biological characteristics are quantified and described. Successional relationships are predicted and portrayed. Table 1-1 displays the hierarchical framework of ecological units[5] for inventory and mapping of climatic, geologic, topographic, and edaphic characteristics, as well as existing and potential vegetation communities.

Table 1-1. NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS[6]

PLANNING AND ANALYSIS SCALE	ECOLOGICAL UNITS[7]	PURPOSE, OBJECTIVES, AND GENERAL USE	MAP SCALE RANGE	GENERAL SIZE RANGE
ECOREGION Global	Domain	Broad applicability for modeling and sampling. Strategic plan and assessment. International planning.	1:30,000,000 or smaller	1,000,000's of square miles
Continental	Division		1:30,000,000 to 1:7,500,000	100,000's of square miles
Regional	Province		1:15,000,000 to 1:5,000,000	10,000's of square miles
SUBREGION	Section	Strategic, multi-forest, statewide, and multi-agency analysis and assessment.	1:7,500,000 to 1:3,500,000	1,000's of square miles
	Subsection		1:3,500,000 to 1:250,000	low 1,000's to 10's of square miles
LANDSCAPE	Landtype Association	Forest or area-wide planning, and watershed analysis.	1:250,000 to 1:60,000	1,000's to 100's of acres
LAND UNIT	Landtype	Project and management area planning and analysis.	1:60,000 to 1:24,000	100's to 10's of acres
	Landtype Phase		1:24,000 or larger	<100 acres

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[4] FSM 2060 and FSH 2090.11

[5] See Appendix J

[6] From U.S. Forest Service, 1993 (see Appendix J)

Information found in ecological guides should address:

- climate,
- physiography,
- hydrology,
- geology,
- soil,
- vegetative community descriptions (seral and potential),
- ecological and successional relationships,
- resource value ratings, and
- management implications.

SCORECARDS

An ecological scorecard is one of several possible tools that may be derived from an ecological classification. A scorecard is normally used to evaluate the status of a specific plant community, estimate resource value ratings, or estimate carrying capacity. The evaluation can be expressed in terms of ecological status[8] or desired condition status.[9]

OTHER TOOLS

Various other tools and information may be developed from an ecological classification. Possibilities include resource value ratings, successional models, old growth scorecards, riparian evaluation guides, and predictive models. Management needs and availability of information will govern their development.

INTEGRATED RESOURCE INVENTORY

Integrated Resource Inventory (IRI) is an integrated approach to resource inventory in the Rocky Mountain Region. IRI focuses on common water, land, and existing vegetation components. A process for developing inventory maps for each component is documented in IRI training guides (U.S. Forest Service, 1995). This process enables Forest Service administrative units to properly integrate specific resource information in preparation for an electronic environment (geographic information system). Project level inventories are designed to nest within the hierarchy established by IRI. Project level inventory data supplements and validates or corrects data from other inventory levels.

The primary objective of IRI is to mesh existing information, provide consistency in how and where lines are drawn, and develop a standard-

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[7] Terms are derived from Bailey, 1983 (Domain, Division, and Province) and Wertz and Arnold, 1972 (Section, Subsection, Landtype Association, Landtype, and Landtype Phase)

[8] The similarity of the seral stage or successional status of a particular plant community with respect to its potential natural vegetation

[9] The similarity of the current plant community to the desired plant community as specified by the desired condition

ized convention for labeling or naming polygons. Existing information is used wherever possible, integrated through interdisciplinary efforts as appropriate for each administrative unit. Since great variability exists in the quality of existing information, each unit evaluates their own information based on IRI guidelines.

The primary focus of IRI is to delineate basic resource related map units (polygons, lines, and points) to support decisions related to Forest and project planning. Integrated resource information supports the legal framework (NEPA, NFMA, and Forest Plans) within which we must operate. Standards allow this information to be reliably aggregated upward to address planning, ecosystem management, and landscape ecology issues across administrative boundaries.

RESOURCE MAP LAYERS

Resource information is grouped into three map layers: common water units, common land units, and common vegetation units. All three layers are dependent on each other and are developed simultaneously.

COMMON WATER UNIT (CWU)

This map layer consists of watersheds, stream networks, lakes, reservoirs, ponds, springs, and seeps. The CWU stratification is hierarchical consisting of four spatially integrated biological, hydrological, and geomorphologic levels: watershed, valley segment, stream reach, and channel unit.

COMMON LAND UNIT (CLU)

This map layer consists of polygons that integrate geomorphology, geology, soil, and potential natural vegetation. It represents the "permanent" terrestrial environment.

COMMON VEGETATION UNIT (CVU)

This map layer consists of existing, or transitory, vegetation (both live and dead). CVU polygons are most often delineated as areas of vegetation possessing sufficient uniformity in regard to species, age, crown condition, layering, size, and density. The area represented by the CVU is generally homogeneous, and is based on physical, observable, and largely quantifiable features and attributes. This is the information most often measured by rangeland analysis methods.

IRI PROCEDURES

IRI procedures include photo-interpretation with the prerequisite validation, and field survey and sampling. Validation of photo-interpretation is a broad process, encompassing many intensity levels. The intensities range from a brief field visit to confirm or reject photo-interpretations, to intensive field sampling which may go far beyond the original photo interpreted attributes. Consequently, there may not be a clear distinction between the two procedures.

Completion of each inventory step is based on information requirements, which vary across the landscape and by management intensity. Most significant is that inventory is conducted commensurate with information requirements and the level of management intensity planned.

PHOTO-INTERPRETATION AND VALIDATION

IRI photo-interpretation is a procedure based primarily on 1:24,000 scale resource photography. Map unit delineations are based on specific criteria for each of the three map layers (CWU, CLU, and CVU). All available information is used to assist in the photo-interpretation process. Each map layer is integrated with the others to identify coincident lines and to assist in further delineation as necessary (vertical integration). All Forest Service administered lands in the Rocky Mountain Region will be mapped with this procedure.

Rangeland mapping and inventory procedures start with IRI products. If IRI maps are not available for the area being analyzed, then IRI guidelines and procedures should be followed. This ensures that energy and resources expended on rangeland inventory will be compatible with products developed later by Inventory Centers.

Field validation of photo-interpretation is accomplished per standards specifically developed for the IRI. The full range of validation intensities may be utilized for validation of photo-interpretation within the Region, and even within a Forest Service unit. Project level needs, available support information, resource availability, and other factors may influence the intensity of the validation effort. Other criteria such as confidence of photo-interpretation, number of acres represented by a particular map unit description, and operational efficiencies are also considered.

FIELD SURVEY AND SAMPLING

The need for site specific, statistically sound sampling of resource information is management driven. A menu of standardized sampling methods for the Rocky Mountain Region is provided; their application will vary based on specific issues. It is likely that an extremely small percentage of the overall landscape area will be intensively sampled.

Specific methods and procedures related to rangeland inventory and analysis are described in detail in the Inventory Chapter.

RANGELAND PLANNING

PURPOSE

Rangeland planning shall prescribe management providing sustainable, natural ecosystems for a variety of values and uses. All planning efforts shall:

- Develop clear, concise objectives that portray desired conditions of rangeland resources for the area involved.
- Develop livestock management strategies that achieve objectives, moving rangeland resources towards desired conditions.
- Develop monitoring standards that enable managers to determine what resource changes are occurring and to make proper management adjustments.
- Develop permittee involvement, understanding, and commitment for management objectives.

LEGAL REQUIREMENTS

Numerous federal laws, regulations, and policies provide guidance for rangeland planning.

THE RECISSION ACT OF 1995

The Forest Service is required by the Recission Act of 1995[1] to develop and successfully implement schedules for the completion of National Environmental Policy Act (NEPA) analysis and documentation on all allotments. Completing NEPA requirements and the resultant allotment management plans is a high priority within our agency and is the focus of this chapter.

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[1] P.L. 104-19, Section 504

FEDERAL LAND POLICY MANAGEMENT ACT AND PUBLIC RANGELAND IMPROVEMENT ACT

The Federal Land Policy Management Act of 1976 (FLPMA),[2] as amended by the Public Rangelands Improvement Act of 1978 (PRIA),[3] allows for inclusion of allotment management plans (AMP) in grazing permits at the discretion of the Secretary of Agriculture.[4] The Secretary exercised this discretion and delegated his authority to issue regulations in this area to the Chief of the Forest Service.[5]

An allotment management plan is defined in FLPMA and PRIA as a document prepared in consultation with permittees applying for livestock operations on the public lands prescribing:[6]

- the manner in and extent to which livestock operations will be conducted in order to meet multiple use, sustained-yield, economic, and other needs and objectives;
- range improvements to be installed and maintained; and
- containing such other provisions relating to livestock grazing and other objectives found by the Secretary to be consistent with the provisions of the FLPMA.

NATIONAL FOREST MANAGEMENT ACT

The National Forest Management Act of 1976 (NFMA) directed preparation of Forest Land and Resource Management Plans on every National Forest. Forest Land and Resource Management Plans, commonly referred to as Forest Plans, provide broad direction for all resource planning and activities. Rangeland project planning implements this direction through site-specific analysis of the rangeland resource.

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act of 1969 (NEPA), and subsequent Council on Environmental Quality (CEQ) regulations, direct all federal agencies to implement a standardized process for analysis and documentation of environmental effects of a proposed action and alternatives to the proposed action. The Act requires scoping of issues, interdisciplinary team involvement in analysis and alternative development, and documentation of the analysis in an Environmental Impact Statement (EIS) or Environmental Assessment (EA). The Council on Environmental Policy Regulations[7] and the Environmental Policy and Procedures Handbook[8] contain requirements for implementing NEPA.

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[2] P.L. 94-579, 90 Stat. 2743, as amended

[3] P.L. 95-514, 92 Stat. 1806

[4] 43 U.S.C.(1752(d)), as amended by 92 Stat. 1803 (1978)

[5] 36 CFR (222.1 et. seq.)

[6] 43 USC (1702(k)), 36 CFR (222.1 (b) (2)), and FSM 1023

[7] 40 CFR Parts 1500-1508

[8] FSH 1909.15

THE ENDANGERED SPECIES ACT

The Forest Service is bound by Endangered Species Act (ESA) requirements. Figure 2-1 illustrates the integration of ESA and NEPA. Section 7 of ESA[9] states:

> "Each federal agency shall, in consultation with and with the assistance of the Secretary [Interior] insure that any action authorized, funded or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in adverse modification of their critical habitat."

Section 7 applies to any discretionary action including granting easements, licenses, permits, and rights-of-way.

In order to fulfill its obligations under ESA, the Forest Service must consult with the U.S. Fish and Wildlife Service (FWS) and provide all pertinent project and species data necessary for them to evaluate the proposed action and its potential to jeopardize federally listed species and or critical habitat designated by the FWS. In order to comply with the ESA, agency personnel must:

1. Obtain a list of threatened, endangered, and proposed species. Contact the FWS to obtain a list of federally listed and proposed species in the action area or that the action potentially affects.
2. Prepare a biological assessment (BA). If Federally listed species or designated critical habitats are present in the affected area, prepare a biological assessment of the effect of the proposed action on Federal land and also the effects that might occur on private land.[10] The Act requires that a determination be made in the biological assessment whether the action has:

    - no effect on, or
    - may affect

    the listed species and/or designated critical habitat. Biological assessments must be approved by journey level (GS-11 and above) biologists and botanists.
3. If a "no effect" conclusion is reached and the action does not involve a major construction project nor an EIS, consultation with the FWS is not required under the law and the action may proceed.[11] A "may affect, not likely to adversely affect" requires informal consultation and subsequent written concurrence from FWS. FWS does not have any specific time frame in which to conclude the informal consultation process unless the action requires an EIS, which then requires a 30-day response from FWS.

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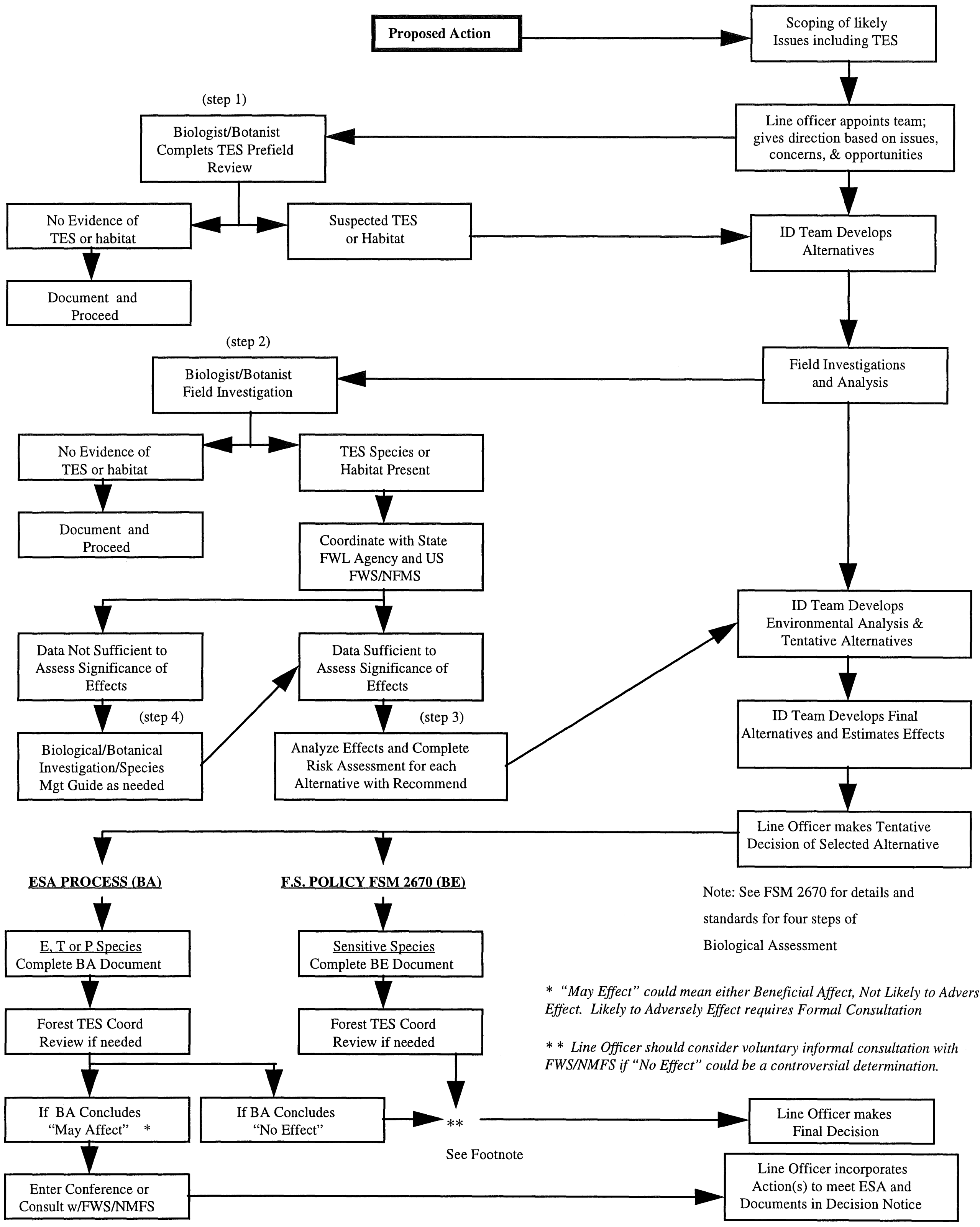
[9] 16 U.S.C. 1536(a)(2)

[10] 50 CFR 402.02

[11] 50 CFR 402.11L

Figure 2-1. INTEGRATING ESA and NEPA


Proposed Action
Scoping of likely Issues including TES
Line officer appoints team; gives direction based on issues, concerns, & opportunities
(step 1)
Biologist/Botanist Completes TES Prefield Review
No Evidence of TES or habitat
Suspected TES or Habitat
Document and Proceed
ID Team Develops Alternatives
Field Investigations and Analysis
(step 2)
Biologist/Botanist Field Investigation
No Evidence of TES or habitat
TES Species or Habitat Present
Document and Proceed
Coordinate with State FWL Agency and US FWS/NFMS
Data Not Sufficient to Assess Significance of Effects
Data Sufficient to Assess Significance of Effects
ID Team Develops Environmental Analysis & Tentative Alternatives
(step 4)
Biological/Botanical Investigation/Species Mgt Guide as needed
(step 3)
Analyze Effects and Complete Risk Assessment for each Alternative with Recommend
ID Team Develops Final Alternatives and Estimates Effects
Line Officer makes Tentative Decision of Selected Alternative
ESA PROCESS (BA)
F.S. POLICY FSM 2670 (BE)
E, T or P Species Complete BA Document
Sensitive Species Complete BE Document
Forest TES Coord Review if needed
Forest TES Coord Review if needed
If BA Concludes "May Affect" *
If BA Concludes "No Effect"
**
See Footnote
Line Officer makes Final Decision
Enter Conference or Consult w/FWS/NMFS
Line Officer incorporates Action(s) to meet ESA and Documents in Decision Notice

Note: See FSM 2670 for details and standards for four steps of Biological Assessment

* *"May Effect" could mean either Beneficial Affect, Not Likely to Adversely Effect. Likely to Adversely Effect requires Formal Consultation*

* * *Line Officer should consider voluntary informal consultation with FWS/NMFS if "No Effect" could be a controversial determination.*

4. A "may affect, likely to adversely affect" requires formal consultation. Formal consultation, which must be initiated by the Regional Forester, requires the FWS to prepare a biological opinion. It must be delivered to the agency within 45 days of the conclusion of a 90-day consultation period, except where both agencies mutually agree to an extension. While informal or formal consultation is in progress, the agency must not make an irreversible commitment of resources that would foreclose implementation of alternate measures designed to avoid jeopardy.

The taking of a threatened or endangered species is prohibited by provisions of the ESA. However, the ESA does allow an "incidental take" provision that may be issued as part of the biological opinion allowing for takings that are incidental to the action and only under the terms and conditions provided in the biological opinion.

If the biological opinion states that the action is not likely to jeopardize the continued existence of the species or to result in the destruction or adverse modification of its critical habitat, proceed with the proposal. If appropriate, incorporate the FWS conservation recommendations into the proposal. The preparing unit must notify FWS in writing of the acceptance or rejection of conservation recommendations and must document the results of the formal consultation in the appropriate NEPA document. If FWS plans to render a jeopardy opinion, the FWS will contact the Regional Forester to discuss any reasonable and prudent alternatives.

Forest Service directives[12] provide additional direction on requirements for compliance with ESA. Proposed species require *conferencing* as opposed to *consultation* under Section 7 of ESA. FSM 2670 should be reviewed to ensure compliance of proposed species that are also protected under the Act.

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[12] FSM 2670

Sensitive species are designated by the Regional Forester. Requirements for protection and management are not addressed in the ESA but are provided by Forest Service policy.[13] Key requirements for sensitive species are:

1. A biological evaluation (BE) must be prepared to review proposed Forest Service actions to determine their potential effect on sensitive species.
2. Biologists or botanists must make a determination of:
    - no impact,
    - beneficial impact,
    - may impact individuals but not likely to cause a trend toward Federal listing or loss of viability, or
    - likely to result in a trend toward Federal listing or loss of viability.
3. Forest Supervisors are required to ensure compliance with procedural and biological requirements for sensitive species and to develop quantifiable objectives for managing populations and/or habitat for sensitive species. A key responsibility is developing and implementing management practices to ensure those species do not become threatened or endangered because of Forest Service actions.

Refer to Standards for Biological Evaluations[14] and Procedures for Conducting Biological Evaluations[15] for more information.

Although many requirements of the Endangered Species Act (and Sensitive Species policy) are completed by biologists and botanists, the rangeland manager must be actively involved to coordinate this effort within the scope and time frames of the overall planning process. Range personnel should be involved where necessary to conduct inventories, delineate livestock use patterns, or supply any other rangeland information to be used in biological evaluations and assessments.

Programmatic Biological Assessments and Evaluations (for all threatened or endangered species and many sensitive species) were completed for livestock grazing in 1995. When initiating a new rangeland management activity, a qualified biologist or botanist must first determine if the existing BA or BE is adequate for the site specific activities being proposed. If the programmatic BA or BE is adequate this should be documented in the NEPA document and no further documentation or analysis is needed. If the programmatic document is not considered adequate then a new or modified BA or BE is needed in order to comply with ESA.

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[13] FSM 2672.42

[14] FSM 2672.42

[15] FSM 2672.43

NATIONAL HISTORIC PRESERVATION ACT

Under the statutory definitions of the 1992 amendments to the Act, grazing permits and livestock management activities are subject to the requirements of Section 106 of the Act.[16] The implementing regulations that apply to livestock grazing activities are found at 36 CFR Part 800. A National Programmatic Agreement (PA) on grazing between the Advisory Council on Historic Preservation and the Forest Service establishes options for meeting the requirements of Section 106 of the Act. PA text can be found in Forest Service directives.[17] Pursuant to Stipulation 2.c. of the PA, State Historic Preservation Officers within the Rocky Mountain Region have signed a Memorandum of Understanding (MOU) with the Regional Forester documenting the specific requirements necessary in rangeland planning. Refer to this MOU[18] for specific requirements related to grazing permit issuance, allotment management plans, and rangeland improvements.

CLEAN WATER ACT

Primary responsibility for protecting water quality rests with the States.[19] Section 313 of the Act[20] requires Federal agencies to comply with all substantive and procedural State water quality requirements to the same extent as any non governmental entity. Refer to interim directives[21] for a listing of specific rangeland management requirements related to the Clean Water Act.

COORDINATION, COOPERATION, AND CONSULTATION

Proper rangeland planning requires close cooperation and consultation with a variety of National Forest and National Grassland users and interested publics. Planning must emphasize the diverse values of Americans who rely on public rangelands for recreation and for economical stability. While federal laws are clear in their requirements for consultation, it remains the sole responsibility of the Forest Service line officer to make range management decisions, including how much grazing will be allowed on National Forest System administered lands.

INTERDISCIPLINARY TEAM INVOLVEMENT

Secure the assistance of the District or Forest interdisciplinary team (IDT) in all steps of the rangeland planning process. Involvement of the IDT will ensure that all resources are considered and that resource conflicts are minimized. Composition of the IDT should reflect the various issues and coordination aspects to be resolved. For example, an aquatic biologist and/or a hydrologist should be a member of the team when riparian or fisheries values are of importance. In some cases, IDT members may accomplish (or help accomplish) some of the evaluation studies. Current planning direction prohibits non Forest Service participants from serving as formal ID team members.[22]

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[16] As amended 16 U.S.C. 470

[17] FSM 1539.61

[18] See Appendix K

[19] As amended 33 U.S.C. 1251 et seq.

[20] 33 U.S.C. 1323

[21] Interim Directive 2209.13-96-1

COOPERATION WITH PERMITTEES

The grazing permittee is integral to any successful rangeland management program. The permittee has a great deal of information as to what is practicable and workable concerning handling of livestock, practicality of grazing systems, and proper location and type of range improvements. The success or failure of the management program will largely be determined by the permittee's willingness to carry out the plan. Consequently, the use of National Forest System rangeland in relation to the rancher's total operation is a fundamental necessity.

Permittee cooperation is essential and their involvement in the planning process is provided for in the Federal Land Policy and Management Act. Permittees should be brought into all phases of the planning process. They should be particularly involved in setting objectives, formulating and selecting alternatives, and preparation of the allotment management plan.

COORDINATION WITH OTHERS

Perhaps the most essential aspect of planning is to recognize the multitude of values and uses on rangelands, and to strive to develop management actions that correspond to the needs and desires of a diverse society. Rangelands are used by hunters, fishermen, hikers, photographers, off-road vehicle enthusiasts, sightseers, and others. Americans have a keen interest in how public lands are managed. For these reasons, local individuals, user groups, and other agencies must be offered the opportunity to be involved in rangeland planning. Identify interested publics before initiating planning and involve them throughout the process. Public land users bring invaluable suggestions and boundless energy to the planning process.

COORDINATED RESOURCE MANAGEMENT

Coordinated Resource Management (CRM), sometimes called Coordinated Resource Management Planning (CRMP), is a formal process designed to bring all interested parties into a joint planning effort. CRM efforts are particularly appropriate when dealing with opportunities or potential effects across multiple ownerships and jurisdictions. CRM is most affective when initiated early in the planning process. Utilize CRM to identify and understand existing and desired conditions, to determine opportunities, and to identify possible management practices for consideration. Handbooks describing the CRM process and its potential uses are available from the Society of Range Management and the State of Wyoming. These handbooks can also be obtained at most Supervisor's Offices or the Regional Office.

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[22] Federal Advisory Communication Act of 1972; 5 U.S.C. 86 Stat. 770; USDA Dept. Reg. 1041-1, 111389

Document all CRM projects in an Interagency Agreement or Memorandum of Understanding (MOU) so that goals, objectives, and procedures are clear. The CRM group must be aware of how their work will be used by the decision-maker.

The Rocky Mountain Region has formal Coordinated Resource Management MOUs with the states of Wyoming and South Dakota. The regional MOU is general in nature and is not a substitute for a project level MOU. The Region and South Dakota have also enacted an MOU describing the allotment planning process.

SECTION 8 AGREEMENTS

Section 8 of the Public Rangelands Improvement Act of 1978[23] states:

> "If the Secretary ..... develop(s) an allotment management plan for a given area, he shall do so in careful and considered consultation, cooperation, and coordination with the ..... permittees, landowners involved, ... and any State or States having lands within the area to be covered by such allotment management plan. Allotment management plans shall be tailored to the specific range condition of the area to be covered by such a plan, and shall be reviewed on a periodic basis to determine whether they have been effective in improving the range condition of the lands involved..... . The Secretary concerned may revise or terminate such plans or develop new plans from time to time after such review and careful and considered consultation, cooperation, and coordination with the parties involved."

The Rocky Mountain Region has a "Section 8" MOU in the state of Colorado involving the Colorado Cattlemen's Association, Colorado Woolgrowers, and the Colorado Commissioner of Agriculture. Other states within the Region have not entered into a Section 8 MOU, but will use the CRM process instead. Activities covered by the Colorado MOU are coordinated by the State Department of Agriculture.[24]

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[23] P.L. 95-514, 92 Stat. 1806

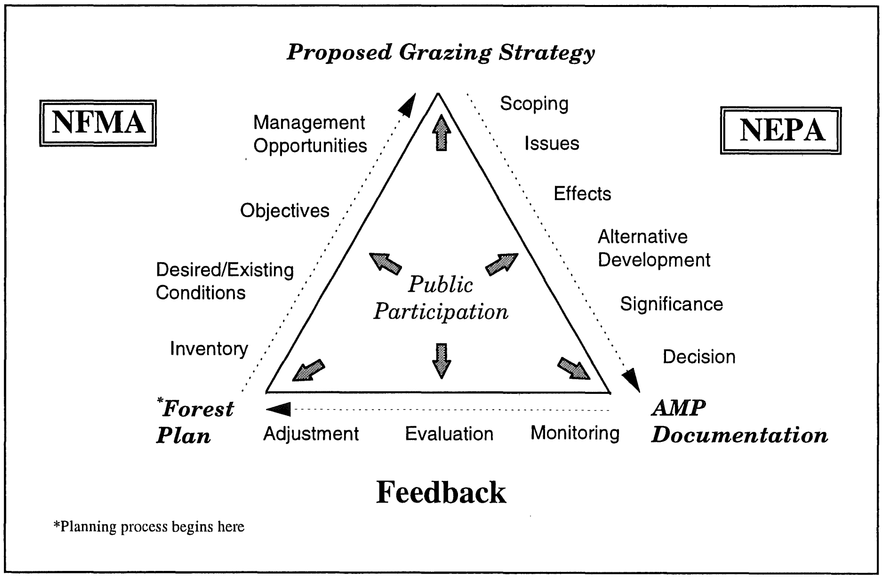
[24] Appendix A contains details and operating procedures for the Colorado Memorandum

RANGELAND PLANNING PROCESS

The rangeland planning process outlined below describes project level planning and decisions. This process includes the site specific analysis necessary to comply with legislation and to implement management strategies to achieve the intent of programmatic direction in Forest Plans. This process can best be described in three steps (Figure 2-2):

1. Compliance with the National Forest Management Act (NFMA).
2. Compliance with the National Environmental Policy Act (NEPA).
3. Preparation of an Allotment Management Plan (AMP).

Figure 2-2. RANGELAND PLANNING PROCESS


Proposed Grazing Strategy
NFMA
NEPA
Management Opportunities
Objectives
Desired/Existing Conditions
Inventory
*Forest Plan
Scoping
Issues
Effects
Alternative Development
Significance
Decision
AMP Documentation
Public Participation
Adjustment
Evaluation
Monitoring
Feedback
*Planning process begins here

STEP 1: NFMA COMPLIANCE

Compliance with the National Forest Management Act consists of defining site specific management objectives and actions that will implement the broad direction of Forest Plans. The end result is a proposed action that adds clear, specific ingredients to the intent of Forest Plans and provides the planning team with a comprehensive strategy upon which to conduct an environmental analysis and documentation. This step includes, but is not limited to, the following tasks. Each is described below in more detail.

- Identify the planning area.
- Determine desired and existing conditions.
- Develop objectives.
- Identify possible management opportunities.
- Formulate a Proposed Action.

IDENTIFY THE PLANNING AREA

Rangeland planning should identify livestock management activities that complement and encourage progress towards the desired condition(s) of an entire landscape. It is important that planning not be a mechanical process, but rather be flexible and fit the local situation.

Considering the issues and local situation, there may be several scales for planning. Two distinct scales are readily apparent: allotment planning and landscape planning. These are obvious planning scales, however, numerous other combinations might be used to address specific situations. It is essential that management determine the scope of the planning effort and prepare a project work plan that obligates both funding and specialists' time to complete the job.

ALLOTMENT PLANNING

In this case, as in the past, allotment boundaries describe the confines of the planning area. The area might include one or more allotments. At a minimum, planning for the allotment must recognize the biological complexity of the entire watershed. Rangeland inventory and analysis emphasize obtaining the information necessary to design allotment management consistent with the Forest Plan.

The level of input and participation by other resource specialists must be sufficient to develop a livestock management strategy aimed at achieving the objectives for desired rangeland conditions. Inventory and analysis at this scale might not contain the necessary information and specialist involvement to support other project proposals.

LANDSCAPE PLANNING

There is an increasing need to inventory and conduct assessments of land areas using integrated teams of resource specialists.

Areas to be assessed may be based upon watersheds or other logical landscapes. The area is not necessarily tied to allotment boundaries but can cover several allotments in whole or in part. Analysis includes all ecosystems, including forested, rangeland, and riparian types. Landscape scale inventory and analysis are an intensive approach to collecting the necessary information from which all resource project proposals can be developed.

Considering resources and issues relevant to the landscape, a team of resource specialists works jointly to analyze potential and existing resource conditions, and to propose projects to help achieve the desired conditions. Project proposals might include wildlife habitat manipulation, timber management practices, watershed rehabilitation, recreation improvements, allotment management, and others. The overall intent of this type of planning is to take a true integrated approach to managing National Forest System resources. Landscape scale planning is becoming the rule, not the exception.

DETERMINE DESIRED AND EXISTING CONDITIONS

Forest Plans reveal broad direction for resource management. Review the Forest Plan to identify management emphasis areas on the allotment (management prescriptions) and the associated standards and guidelines. Management prescriptions describe the resources that should be emphasized on certain locations within the area. Forest Plans are not intended to provide all the necessary information for rangeland project decisions. The rangeland planning process will refine the broad desired condition(s) described in the Forest Plan.

Forest Plans do not prescribe site-specific ecosystem characteristics. Specific characteristics, existing and desired, of soil, vegetation, and water can only be identified through integrated resource inventory and evaluation. Involve a diverse group of resource specialists, permittees, and interested publics to accomplish the inventory and evaluation of resource conditions.

Existing conditions are determined from inventories, trend data, historical files, and professional judgment of the planning team. Permittees provide invaluable information on past allotment history and how that history applies to current conditions. Much of this guide deals with accepted methods used to collect current resource information. While current information is important, it should be recognized that collecting existing resource data is only a portion of the overall attempt to develop a strategy to achieve the desired condition.

The quantity and quality of existing resource information needed will vary between planning areas, based upon apparent rangeland conditions, management complexity, conflicting interests, and controversy. Inventory data collected through the validation phase of Integrated Resource Inventory (IRI) may suffice on some areas. Other areas may require rigorous evaluation of vegetative, soil, and watershed parameters through combined methods. Inventory intensities are discussed in more detail in the Inventory Chapter (page 3-3). At a minimum, existing plant communities should be verified and an assessment made of rangeland conditions.

Desired conditions are determined by identifying management emphasis areas and then selecting the appropriate mix of plant communities needed to maximize conditions for the resource emphasized. For example, a mix of several shrub plant communities, with varying size and age classes, may be recommended for a wildlife winter range emphasis area. Selected desired plant communities must be able to occupy the site under realistic management practices. The planning team must be able to:

- define ecological types and the various plant communities that could exist there, using an approved ecological classification,
- recommend desired plant communities that occur on similar sites in the vicinity of the planning area, or
- describe desired vegetation and ground cover characteristics to be accomplished through the allotment management plan.

Instructions for determining existing and desired plant communities are described in more detail later (page 3-7).

DEVELOP OBJECTIVES

Developing objectives is the most important portion of NFMA compliance. The toughest part of setting objectives is describing the result -- not the action to be taken. ***An objective is a clear, concise statement of measurable results to be achieved within a stated time period.*** Objectives should describe the specific resource characteristics that are desired, such as desired plant communities, water quality standards, and soil conditions. Developing objectives at this early stage in the process is paramount to a successful planning effort.

After writing an objective, read it and ask the question "Why?". If there is an answer that better describes the purpose of the proposed action, then the objective is not adequately described yet. For example:

Original Objective: Reduce sagebrush densities. Why?

To reduce competition with herbaceous vegetation. Why?

To achieve greater ground cover in Pine Creek drainage. Why?

To improve water quality in Pine Creek.

This is close to an objective. After describing the water quality parameters desired and how soon they are to be achieved, the objective will be complete. For example, the final objective may be to convert 50 percent of the sagebrush community (ARTR2-POPR) in Pine Creek drainage to a grassland community (FEID-STLE4) by the year 2005. Reasonable management opportunities can then be identified for accomplishing the objective. Identifying the opportunities becomes much easier when specific objectives are known.

IDENTIFY POSSIBLE MANAGEMENT OPPORTUNITIES

Management opportunities that promote progress towards objectives should be identified. Opportunities might include grazing systems, improvements, vegetation manipulation, or management practices (such as riding, salting, and kind and class of livestock). Inclusion of resource specialists, permittees, and other interested publics is critical at this stage. The diverse composition of the planning team will encourage a broad range of management opportunities.

Evaluate all opportunities to measure their potential effectiveness in helping to achieve objectives. Good management opportunities are those with potential to move the existing plant community towards the desired plant community. Management opportunities must consider the entire area, and not be confined by artificial or jurisdictional boundaries. Identifying management opportunities should be a brainstorming endeavor that produces a wide range of innovative opportunities to be formulated into a proposed action.

FORMULATE A PROPOSED ACTION

In the ideal situation, a landscape-scale inventory and analysis (page 2-11) will provide a foundation of information that can be used for multiple resource proposals and projects. These proposals, implemented either together or individually, will accomplish the desired condition objectives that were agreed upon for the area.

At this stage in the process, land managers should decide upon the scope of the proposed action within the National Environmental Policy Act context. In many cases the proposed action may be strictly a livestock management strategy. In other situations the livestock management strategy may be combined with other resource activities such as wildlife habitat improvement, timber sales, recreation development, and others, to be more efficient.

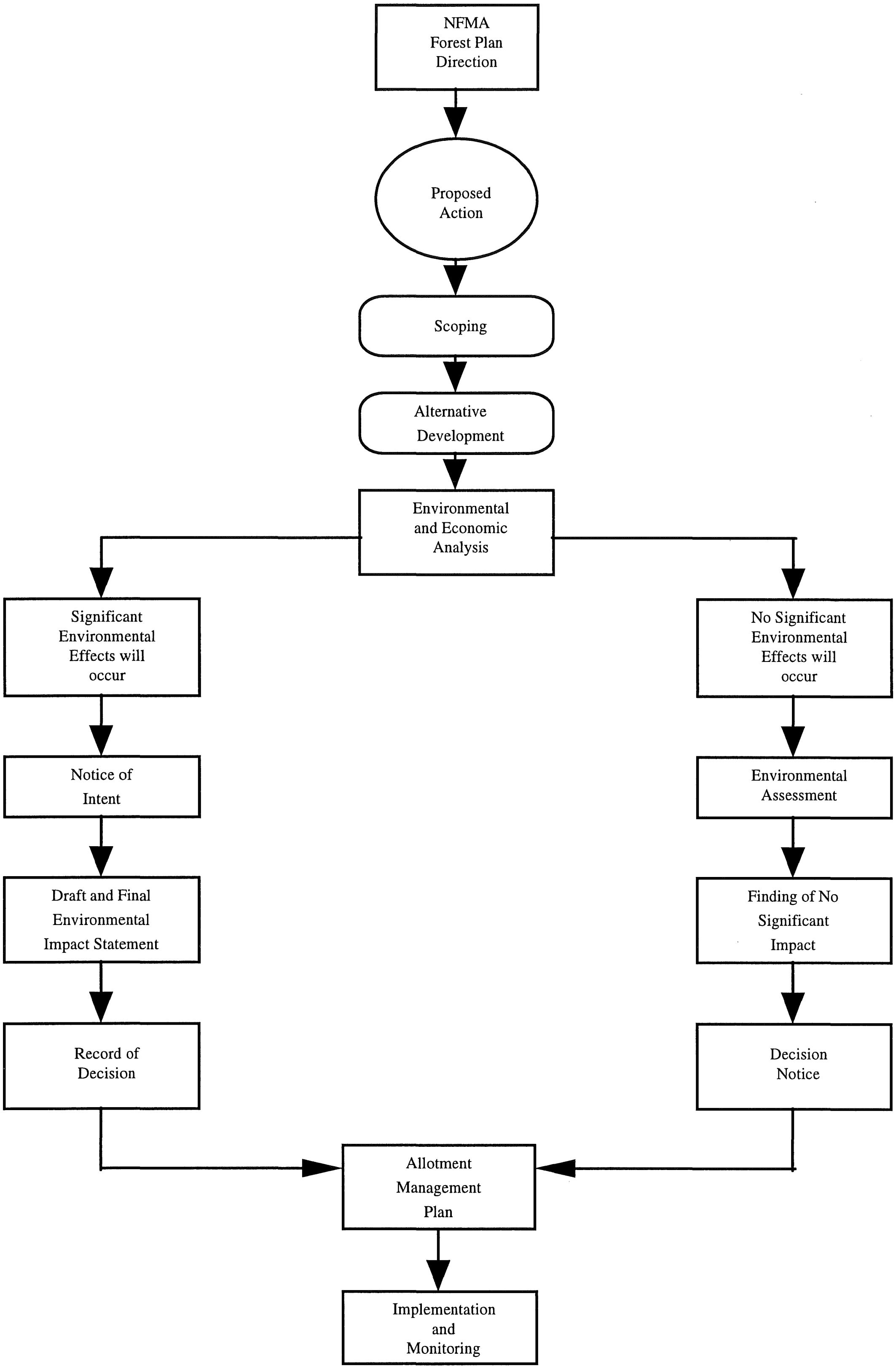
At a minimum, the proposed action should be feasible for the Forest Service and permittee to implement. Specific details must be documented so that the action will address all known issues. Identification of the proposed action will initiate the National Environmental Policy Act compliance.

STEP 2: NEPA COMPLIANCE

Compliance with NEPA requires an environmental analysis and documentation (Figure 2-3) of the analysis in an Environmental Assessment (EA) or Environmental Impact Statement (EIS). The analysis is an investigation of the proposed action and alternatives to accomplishing that action; and their direct, indirect, and cumulative environmental impacts. The analysis provides necessary information for reaching an informed decision, and also determines the type of documentation required. The NEPA process includes:

- Descriptions of the proposed action, purpose and need for that action, and the decision to be made.
- Scoping and issue identification.
- Alternative development.
- Environmental and economical effects.
- Findings based upon significance.
- Documentation in EA or EIS.

Figure 2-3. NEPA DOCUMENTATION


NFMA
Forest Plan
Direction
Proposed
Action
Scoping
Alternative
Development
Environmental
and Economic
Analysis
Significant
Environmental
Effects will
occur
No Significant
Environmental
Effects will
occur
Notice of
Intent
Environmental
Assessment
Draft and Final
Environmental
Impact Statement
Finding of No
Significant
Impact
Record of
Decision
Decision
Notice
Allotment
Management
Plan
Implementation
and
Monitoring

NEPA requires that a formal interdisciplinary team (IDT) be established. This team may involve some or all of the planning team members included in NFMA compliance. The disciplines and skills of this group must be appropriate to the scope of the action and the issues identified. The number of persons on the team should be manageable. Other resource specialists can serve as support for a core IDT.

Forest Service directives[25] and Council of Environmental Quality (CEQ) regulations[26] provide detailed information on compliance with NEPA. All range managers and line officers with planning responsibilities should be familiar with these documents.

PROPOSED ACTION: PURPOSE AND NEED

This phase of the NEPA process simply consists of documenting details of the proposed action and why the action is needed. Specific details of the proposed action should be thoroughly explained so that misconceptions and unfounded conclusions are kept to a minimum. The proposed action purpose and need are the foundation for the entire NEPA analysis.

SCOPING AND ISSUE IDENTIFICATION

This phase of NEPA compliance consists of outreach to the public for issues of concern. Many issues will have already surfaced through involvement of interested persons in NFMA compliance. NEPA scoping is broader based and will reach out to more of the general public, other agencies, state and local governments, and others. The intent of NEPA scoping is to identify all significant issues related to the proposed action. Issues identified through scoping will often result in modification or addition to the objectives documented in NFMA compliance.

Letters, media contacts, public meetings, open houses, and other forms of notification may be required, depending upon the complexity and controversy of the planning effort.

ALTERNATIVE DEVELOPMENT

Alternative development is crucial to a good planning process. Clearly defining the objectives, purpose and need, and issues allows the IDT to focus on development of good alternatives. All alternatives must promote progress towards achieving the objectives. With the possible exception of the required no-action alternative, alternatives that do not move resources towards the objectives are not reasonable. Permittees should be involved in alternative development. Alternatives that meet objectives, but cannot be implemented by the permittee, are probably not reasonable. A great deal of thought and creativity is required to develop a range of alternatives that are acceptable in terms of accomplishing the objectives. Formulating good alternatives allows for a true comparison of environmental and economical effects between the alternatives.

CEQ regulations for implementing NEPA require a no-action alternative be developed as benchmark from which the agency can evaluate the proposed action. No-action in rangeland planning is interpreted as no livestock grazing. Consequently, environmental and economic effects of the various alternatives are compared with those effects projected from no grazing. In addition, an existing management (or status quo) alternative should be considered in many situations.

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[25] FSH 1909.15

[26] 40 CFR Parts 1500-1508

Alternatives should be well thought out and defined. They must contain sufficient detail to allow for determining effects and a clear basis for choice among options. Mitigation measures should also be explained. Consider reasonable alternatives that include management of lands outside Forest Service jurisdiction where appropriate.

ENVIRONMENTAL AND ECONOMIC EFFECTS

This provides the analytical basis for comparison of alternatives. The analysis should estimate direct, indirect, and cumulative environmental effects from implementing each alternative. Evaluating the effects of livestock grazing on every biotic and abiotic component of the ecosystem is virtually impossible. Your effects must address, however, those resources that were accepted as issues or those resource effects mandated by law, regulation, and policy. Estimate the effectiveness of mitigation measures for each alternative. The IDT plays a major role in insuring that effects are properly disclosed.

The analysis should also disclose social and economic effects. The Code of Federal Regulations,[27] Forest Service directives,[28] and NEPA each requires allotment management plans to contain cost effectiveness analysis using prescribed cost effective procedures. Projects with an estimated cost exceeding $25,000 require a benefit-cost analysis. Projects under $25,000 require a least cost analysis. Conduct cost effectiveness analysis as part of the effects determinations. Determine cost effectiveness for each alternative using the DGECON Model (U.S. Forest Service, 1989). Cost effectiveness should be a major consideration in decision-making.

In addition to cost effectiveness analysis there are several other legal and policy requirements to be addressed in the effects analysis. A biological evaluation (BE) or biological assessment (BA)[29] must be prepared to determine effects on threatened, endangered, and sensitive (TES) species. Effects of each alternative upon cultural resources must also be evaluated according to Section 106 of the National Historic Preservation Act.[30] Effects of the alternatives on water quality must be addressed as mandated in the Clean Water Act. Preparation of a Noxious Weed Risk Assessment is required for all ground disturbing activities,[31] and ensures that the potential for spreading noxious weeds is considered in rangeland planning.

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[27] 36 CFR 222.1 (2) (i)

[28] FSM 2212.03 (8)

[29] FSM 2672.43

[30] P.L. 89-665

[31] FSM 2080; see Appendix B

Estimating effects is really the essence of NEPA compliance. The public demands and deserves accurate information on the effects of proposed rangeland management. Rangeland managers, through the interdisciplinary process, should ensure all effects are accurate and fully disclosed.

FINDINGS OF SIGNIFICANCE

Environmental analysis determines the significance of effects on the human environment. The significance of effects determines which environmental document to prepare (Figure 2-3). If no significant effects are likely to occur, then an EA is prepared. If significant effects will occur, then an EIS must be prepared. Most rangeland planning efforts will require an EA, a Finding of No Significant Impact (FONSI), and a Decision Notice that documents the action to be implemented. Rangeland planning should not be categorically excluded from documentation.

DOCUMENTATION

Preparation of environmental documents is explained in detail in Forest Service directives[32] and in the CEQ regulations.[33] Figure 2-3 illustrates the NFMA/NEPA process requirements leading to documentation of the decision. The decision document that will accompany the EA or EIS describes more thoroughly the management action(s) to be implemented on the ground.

STEP 3: AMP PREPARATION

The authority for allotment management plans (AMP) lies within FLPMA and 36 CFR 222.1 and 222.2. The AMP is the implementation plan for the actions analyzed in the NEPA process and selected in the decision document. The AMP specifies the actions needed to manage rangeland resources for livestock grazing, and must integrate resource goals and objectives for all resources with livestock grazing.

The AMP is the implementation document by which the Forest Service communicates to the permittee and others: management objectives, planned actions to accomplish those objectives, and monitoring necessary to determine if progress towards objectives is being made. A good AMP is brief and to the point.

ELEMENTS OF THE AMP

Each allotment management plan must contain sections on objectives, management actions, improvements, and monitoring and evaluation.[34]

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[32] FSH 1909.15

[33] 40 CFR Parts 1500-1508

[34] FSM 2212.2

Other sections may be added depending on the scope and complexity of allotment management. The suggested AMP outline follows.

COVER PAGE

A separate (approval) cover page will be used for the allotment management plan. It includes the allotment, Ranger District, and National Forest names, and has preparer, permittee, recommended, and approval signatures on it. The AMP implements the NEPA decision and is not a new decision, nor is it appealable. If the permittee refuses to sign, then state the reasons and proceed with the decision implementation.

PERMIT STATEMENT

A statement is needed which says: "This Allotment Management Plan is made part of your (Term/Temporary/Private Land) Grazing Permit in accordance with Section .... of that permit, approved on ..... ." This statement can be written on the cover page with the signatures.

GOALS AND OBJECTIVES

This section must contain objectives for management of rangeland resources and livestock grazing. The objectives are generally the same objectives as described throughout the planning process. These objectives describe the desired condition for rangeland vegetation and other rangeland resources.

This section also contains a brief summary from the EA or EIS on the present allotment condition and situation, to put the pathway from the present situation to the desired condition into perspective.

Objectives must be clear and specific statements of planned results to be achieved within a stated period of time. The results indicated in the statement of objectives are those which are designed to achieve the desired state. Objectives must be sufficiently specific, concise, quantifiable, and measurable to allow for monitoring; must relate to desired conditions; and must contain a projected date for planned achievement (page 2-14). Objectives in the allotment management plan are basically a refinement of objectives developed during NFMA compliance.

MANAGEMENT ACTIONS

Document the number of permitted livestock, kind and class of livestock, season of grazing use, and grazing system to be used. The grazing system or formula must be described in words and graphic or tabular form so it is clear to all parties.

A tabular listing of range improvements, both existing and proposed, the condition of existing improvements, and a listing of maintenance responsibility is required. Include schedules for:

- rehabilitation of ranges in unsatisfactory condition, including noxious weed infestations, and
- initiating range improvements with responsibilities for costs and labor incurred and planned completion dates.

Describe the contribution each grazing treatment makes toward meeting the objectives, and how conflicts and issues will be resolved. Management actions needed to meet objectives for other resources and uses should be stated. Management and coordination needs for threatened, endangered, and sensitive species should be addressed. Incorporate applicable standards, guidelines, and management requirements from the Forest Plan.

PROPER USE CRITERIA

Proper use criteria shall be put in writing for each unit or special management situation on the allotment. Specify maximum use guidelines for key areas within the allotment, and maximum acceptable disturbance levels for stream banks and vegetation components in riparian areas. The criteria shall also specify maximum acceptable ground cover disturbance, if appropriate, to protect the soil resource. Define proper use criteria in terms of utilization levels or residue left after grazing.

MONITORING AND EVALUATION

Outline monitoring actions needed to determine compliance with objectives. From an administration perspective, evaluation and monitoring procedures should be planned within the available resources. It may be helpful to prioritize monitoring activities or specify minimum monitoring requirements. Monitoring and evaluation should address:

- Actual livestock use, season, and numbers.
- Ecological status and condition of capable rangeland (acres meeting or not meeting Forest Plan and AMP standards).
- Trend of benchmark community types and other capable rangelands toward desired condition (for example, satisfactory livestock forage resource value rating).
- Streambank alteration and stability, and vegetation trend in riparian areas.
- Compare intensity map with the proper use criteria for firming up capacities. Include time frame for mapping to coincide with completion of grazing system and what will be done if use intensity does not met objectives, such as changes in stocking or management systems.
- Increase or decline of inventoried noxious weed infestations.
- Compliance with other management requirements of the Forest Plan, AMP, and annual operating instructions.

Members of the IDT should help decide what specific monitoring information will be needed in order to determine if the goals and objectives of the management plan are being met. Long-term soil and monitoring techniques should be employed to evaluate and document short term dynamic occurrences. Reference the Monitoring Chapter for a complete discussion of monitoring and evaluation.

ANNUAL OPERATING INSTRUCTIONS

Include annual operating instructions that the appropriate Forest Officer shall review each year and, in consultation, coordination, and cooperation with the permittee, revise as necessary. These instructions, in straight-forward language, define and describe what is expected and required by the permittee for the current year.

GRAZING SYSTEM DESIGN

Management system design is an extremely important part of the AMP for any allotment. A successful grazing system must:

- Move or maintain resources towards the desired condition.
- Provide watershed protection.
- Provide sustained production for livestock and wildlife.
- Be flexible to allow for unpredictable seasonal precipitation and forage production.
- Provide forage reserves for drought periods.
- Maintain or enhance habitat for wildlife and fishery resources.
- Be integrated as closely as possible with overall ranch plan objectives.
- Be simple, workable, and easily understood and followed.
- Be compatible with or enhance other resources and uses.
- Be tailored to the inherent characteristics of the soil, vegetation, and topography.
- Be cost-effective in terms of construction, maintenance of necessary range improvements and management, and administration time.

GRAZING SYSTEMS ON CATTLE ALLOTMENTS

Grazing systems on cattle allotments shall generally provide for a maximum amount of re-growth after grazing. Season-long grazing should be phased out, and some form of rest or deferment should be emphasized. Rest-rotation, deferred rotation, high intensity-short duration, and several other grazing systems are acceptable. Riparian areas should be a prime consideration in designing a grazing system. Grazing systems in riparian areas should emphasize short-duration use with total rest and maximum re-growth for the rest of the growing season. No system is ideal for all situations, so the grazing pattern must be tailored to the individual allotment. Systems must be flexible so that changes can be made as needs arise.

Almost all grazing systems on cattle allotments require good water distribution. Allotment management planning should address the needs for additional water sources. Permittee salting and riding practices play a key role in the success of any management system. Salt should be placed well away from water sources and used as a means to distribute cattle throughout the unit. All grazing systems require that the permittee spend considerable time on the allotment, moving cattle out of concentration areas and sensitive riparian areas.

Perhaps the most important aspect of planning any grazing system is gaining the full support and commitment from the permittee. The rancher must be willing and able to administer the system, and the system must be realistic. A variety of grazing systems can be successful if the permittee is fully committed to the objectives and provides the necessary effort to make the system work.

GRAZING SYSTEMS ON SHEEP ALLOTMENTS

Much of the material presented in this guide is oriented toward cattle management. Generally, the conceptual approach and the procedures apply equally well to sheep management but some differences should be recognized. The following information describes some of the features of sheep management and handling that must be kept in mind during management planning for sheep allotments.

SHEEP GRAZING HABITS

Good sheep husbandry is not normally compatible with heavy use. Sheep should be allowed to seek their own level of forage utilization. They prefer different plants at different times of the year and this should be considered in designing the management prescription. Once-over grazing is highly desirable, even under rest-rotation type of management.

Sheep are finicky feeders in the morning and choose only tidbits of the choicest plant. They settle down and feed better in the evening, and are not nearly as selective in their choice of forage. The less the herder handles the herd, the better the animals thrive. However, in order to systematically graze an allotment, checks and controls must be applied by the herder.

Sheep prefer fresh feed each day. However, elapsed time will allow the feed to freshen up, particularly after a rain. Open herding results in less travel. If use is forced, the herder must tighten the spread of the herd resulting in trampling damage to the range and adverse effects on the sheep.

SHEEP MOVEMENT AND HERDING

Moderate topography is best for ease of handling. Thick brush acts as a barrier to grazing sheep even though there are trails through the brush.

Heavy stands of sagebrush are also barriers to a grazing herd. On most summer allotments, sheep will graze upslope after leaving their afternoon watering and bedding site. They will then regroup and bed down for the night on a ridge top or some other high vantage point. They instinctively use these high points for protection and vantage. Sheep do not like to night bed in thick trees or in the bottom of basins, or depressions. From the high point, they will usually begin grazing at daybreak.

It is very important the herder be with the flock to influence the direction when they begin to graze. The sheep will otherwise often graze the same direction as they did the previous day, watering at the same site and bedding down on the same bed ground. This results in poor lambs and excessive trampling along the persistent routes of travel. When sheep leave the shade-up area during warm weather, they tend to graze on the shady side of the canyon and avoid open slopes. Sheep will usually not graze downhill in the evening.

It is difficult to force sheep to shift from succulent forage, such as shifting from forbs to mature grass. Feed is generally more succulent on cooler north and east aspects. During warm weather, sheep make good use of aspen and similar range. They prefer to graze in the shade of the trees in the afternoons after leaving the shade-up area.

During cool or stormy weather, sheep have a tendency to travel. During warm summer days, sheep shade-up from mid morning to late afternoon. Under these conditions, sheep begin grazing at daylight and again from late afternoon until dark.

Water distribution and location are important to sheep. The ideal situation is to have water available in the bottom of every canyon. It is sometimes a management advantage to pipe water from hillsides to developments in the canyon bottom. It is difficult to force sheep to use the slopes below available water on hillsides. Watering sites should be close enough so excess trailing is unnecessary. Sheep should not be required to go more than a mile to water. Doubling the distance sheep travel to water increases the grazing use adjacent to the water source several times.

It is difficult to get sheep off steep slopes once they are established there. The herd will delay going to water until they are very thirsty. They will then trail (often on a run) off the slope with resulting damage to the range and slopes.

OVERGRAZING AND UNDERGRAZING PORTIONS OF THE RANGE

Both the herder and the sheep follow the path of least resistance. The most accessible and easily herded portions of the range will be grazed most heavily. Areas adjacent to water, especially if water is scarce, receive heavy grazing pressure. If shade-up areas are limited, the available shady areas will receive heavy use during warm weather. Shading up too often in one place is as damaging as repetitive use of bed grounds.

Sheep also prefer the upper half of slopes and ridge tops. These areas, particularly ridge tops, should be closely watched and evaluated. On the other hand, some portions of the range tend to be under utilized. Small isolated corners, slopes cut up or isolated by rocks or brush, the lower portions of long slopes, slopes below available water, steep, rough country, and some of the timbered areas fit into this category.

ADDITIONAL CONSIDERATIONS

Other factors to consider when designing grazing management by sheep:

1. Where possible, avoid placing allotment boundary lines (common to two allotments) on ridge tops. Sheep naturally prefer to graze the upper portions of slopes and ridge tops. When allotment lines are placed on ridge tops, the result is double use of these areas. Sheep from both sides of the ridge graze and may bed on the ridge top. Some problems can be alleviated or corrected by placing common boundaries on drainage bottoms.

   Many boundaries are more or less fixed and are difficult to change. Where this situation occurs, alleviate problems with special instructions to the permittee and the herder. These instructions normally should be placed in the annual operating instructions. The instructions may prohibit bedding the sheep on certain ridge tops and/or specify that these areas receive only light use.

2. Sometimes small non capable areas occur within large areas of capable range. These areas may have shallow soil with little vegetation. They are sometimes delineated on maps furnished to the herder and owner and shown as "closed to grazing." This creates an impossible situation for the herder due to the impracticality of keeping sheep off many of these small areas. When this situation exists, the range manager must choose to either:

   - change the grazing formula either to protect these areas or to enable them to be grazed in a manner that they would not be damaged, or
   - close a large enough area around the non capable sites so it is possible for the herder to keep the sheep off them.

3. Sheep should be managed on the basis of "once-over" grazing under rest-rotation or deferred rotation management. Cattle are placed in a pasture or grazing unit and confined there until the desired degree of use is obtained; this approach is undesirable with sheep.

   Permittees usually want their sheep with lambs on fresh feed every day to put weight on their lambs. If sheep are confined to a grazing unit until heavy utilization is attained, lambs will not do well and the permittee will be opposed to the grazing management system. Similarly, if sheep are confined to a grazing unit, soil damage from trailing and trampling by sheep is usually unacceptable.

RANGELAND INVENTORY

INTRODUCTION

This chapter provides basic information necessary to conduct rangeland inventory. It is designed to provide instruction for field survey and sampling of grazing allotments. Rangeland inventory involves identification of plant species and their relative composition, determination of relative rangeland health, preparation of an allotment analysis map, and summarization of data for range planning decisions. In order to conduct a reliable inventory, ***good plant identification skills are mandatory***.

Two situations will be encountered in the Rocky Mountain Region:

- inventory *with* a formal ecological type classification, and
- inventory *without* a formal ecological type classification.

The inventory procedures utilized depend on whether or not a classification is available. Most rangeland ecosystems within the Region are not formally classified.

WITH A CLASSIFICATION

An ecological type classification defines and describes successional (seral) community types, including the potential natural community. Each description includes information on biotic (vegetation composition, abundance, and productivity) and abiotic (climate, landform, and soil) characteristics, as well as seral relationships between communities, resource value ratings, and community response to management activities. Rangeland inventory and analysis aided by a set of classification tools can facilitate desired plant community determination by first, clarifying the range of viable possibilities and second, quantifying and qualifying the community type properties. Ecological status can easily be determined by comparing the existing plant community to the potential natural community.

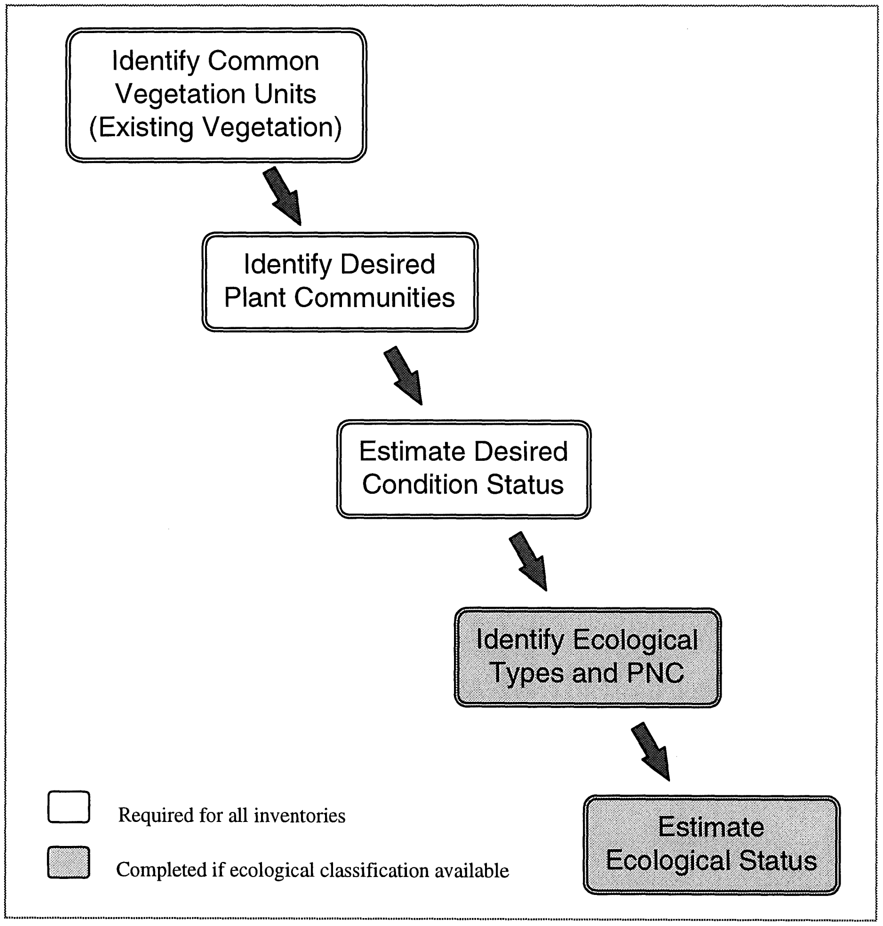
WITHOUT A CLASSIFICATION

Potential natural communities (PNC) are not well defined nor described without an ecological type classification. Consequently, the rangeland inventory and analysis process must concentrate on existing vegetation. Specifically, the process will compare existing plant communities to a desired plant community. The desired community may be occur within the general area, on sites with similar environmental characteristics — the optimal scenario, or it may be a composite developed by the interdisciplinary team of key characteristics which if achieved will establish a trend towards the desired plant community. The degree of similarity between existing and desired plant communities approximates desired condition status (page 3-10).

RANGELAND INVENTORY REQUIREMENTS

The inventory process portrayed in Figure 3-1 is discussed in detail throughout this chapter.

Figure 3-1. RANGELAND INVENTORY PROCESS


Identify Common Vegetation Units (Existing Vegetation)
Identify Desired Plant Communities
Estimate Desired Condition Status
Identify Ecological Types and PNC
Estimate Ecological Status
Required for all inventories
Completed if ecological classification available

PRIORITIES AND INTENSITY

Rangeland analysis is the systematic collection and evaluation of rangeland resource data. The Forest Supervisor shall establish analysis priorities, analysis intensities, and the area to be analyzed.

PRIORITIES FOR ANALYSIS

1. Allotments not meeting Forest Plan standards and guidelines.
2. Allotments with threatened, endangered, or sensitive plant or animal habitat that are impacted by livestock grazing.
3. Allotments with big game-livestock conflicts.
4. Allotments without NEPA or Forest Plan compliance documentation.

INTENSITY OF ANALYSIS

Minimum requirements for accomplishing the inventory phase of the rangeland analysis process can be found in Forest Service directives.[1]

Factors to be considered in determining sampling intensity are: complexity or sensitivity of known or anticipated resource use conflicts or controversy, diversity of vegetation types, ecological status, trend, and the desired level of precision. Sampling intensity is dependent on the kind, quality, and quantity of data needed. In determining the sampling intensity, the examiner should weigh the desired level of inventory against funding and personnel capabilities. Professional judgment plays a major role in making these determinations. Table 3-1 provides guidelines for determining the appropriate level of inventory intensity.

Table 3-1. GUIDELINES FOR ANALYSIS INTENSITIES

INTENSITY	BASE LEVEL	MID LEVEL	HIGH LEVEL
WORKING RELATIONSHIP	Cooperative	Cooperative or potential for conflict	Non-cooperative
RANGELAND CONDITION	Satisfactory	Some areas are unsatisfactory	Unsatisfactory
GRAZING MANAGEMENT	Minor or no changes are sufficient	Moderate changes in grazing system or improvements are required	Major changes in stocking levels and/or management strategies needed
OTHER RESOURCE ISSUES OR CONFLICTS	No significant issues or resource conflicts exist	Potential issues have been identified and minor conflicts expected to develop	Major issues are identified; conflict resolution necessary
ALLOTMENT MANAGEMENT PLANNING	Need rewritten, easy AMP design and straight forward EA	Moderate changes in AMP are required, with an EA	Major changes with EA or EIS
PERSONNEL REQUIRED	Team Leader plus a few technical consultants	Team Leader plus a small interdisciplinary team	Full interdisciplinary team including specialists
PROCEDURES	• Prepare allotment boundary map showing: pastures, improvements, and vegetation (CVU) • Field reconnaissance of rangeland conditions using: Rangeland Health Matrix (R2-2200-RH) in key upland sites, and Proper Functioning Condition (BLM-PFC) in key riparian sites • Establish extensive monitoring	Base level, plus: • Validate capable rangelands as determined in Forest Plan • Inventory CVU polygons with cover-frequency and/or line intercept transects, supplemented with ocular plant composition plots • Select desired plant communities • Establish extensive monitoring for satisfactory sites and intensive monitoring on unsatisfactory sites	Mid level, plus: • Install rooted nested frequency transects along with cover- frequency transects to monitor trend • Consider production-utilization studies (minimum of 3 years)

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[1] FSM 2212.11; also refer to FSM 2060 and FSH 2090.14

AREA INCLUDED

Rangelands to be analyzed include:

- Rangelands within the allotment that are grazed by permitted livestock, including non-Forest Service administered lands if those lands are used as basis for private land permits.
- Public and private rangelands within or adjacent to allotments where the Forest Service is cooperating with other Federal agencies, state agencies, or private landowners in the development of coordinated allotment management plans.
- Rangelands outside active allotments as necessary to meet objectives for resources such as wildlife or watershed.

OFFICE PREPARATION

Office preparation includes gathering available information contained in the 2210 and 2230 folders. Much of the preliminary aerial photo interpretation can be done in the office and verified during field work. Sources of information include:

- Forest Land and Resource Management Plan, especially the inventory and data base, and the maps prepared for the Plan.
- Integrated Resource Inventory (IRI) photo-interpretation and field verification maps and data base.
- Old range maps and records.
- Old allotment management plans.
- Timber survey, range site (NRCS), soil inventory, and soil-vegetation maps, such as Multiple-Use and Area Guides.
- Annual range inspections, and range readiness, utilization, and actual use reports.
- Personal testimony by permittees, State wildlife agency personnel, public groups maintaining data bases on ecology, and Forest users. Grazing permittees can provide information on locations of existing and needed range improvements, capable range, problem areas, and livestock distribution and use habits.
- Aerial photographs (recent and past).
- Photographs and camera point records.
- Wildlife use, census, and habitat analysis records.
- Fish and Game Department reports and studies.
- Land adjustments and status records.
- County records for land ownership.

ALLOTMENT FAMILIARIZATION

It is imperative field examiners be intimately familiar with the allotment regardless of the inventory intensity level used. There is absolutely no substitute for personally conducting the following:

- Review allotment folders and files concerning the allotment. These records provide insight into grazing use history and various problems and opportunities on the allotment. Discuss the allotment with the permittee(s) and other interested parties in order to determine past and present use, patterns of livestock use and movement, problem areas, and potential range improvements.
- Become knowledgeable concerning the presence of threatened, endangered, and sensitive species and their habitats within the allotment. The Forest wildlife biologist or botanist can assist with this, as well as The Nature Conservancy.
- Locate and describe desired plant communities (DPC) and/or potential natural communities (PNC). Data from these areas are required for similarity analysis, to develop ecological type classifications, and to prepare ecological guides. Search the allotment for undisturbed or relatively undisturbed occurrences of DPC or PNC. However, when comparing undisturbed sites with other portions of the allotment, *care must be taken to ensure they are ecologically similar.*
- Observe the use patterns of livestock and wildlife. Utilization studies are helpful aids.
- Identify key areas for wildlife species of interest on the aerial photos or GIS base maps, by coordinating closely with wildlife biologists and local state wildlife officials.
- Determine if the Common Land Unit[2] map or soil resource inventory is complete for the allotment. If available, use them to the fullest possible extent. If they are not available and cannot be scheduled in a timely fashion, the project leader must arrange for the collection of soil information with the help and advice of a soil scientist. In addition, soil parent material observations should be made along with general observations on watershed damage, gully systems, and sheet erosion.
- Observe and record all water locations on aerial photos or GIS base maps. Water availability and location are major factors influencing livestock and wildlife distribution. It also has a bearing on range capability and influences range management planning. In areas where water is in short supply or is poorly distributed, there may be a greater potential for conflict between various uses.
- Become familiar with allotment boundaries and accurately locate them on aerial photos with a stereoscope, or on the base

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[2] Integrated Resource Inventory

map. They should be ground-truthed to be certain they conform with the approved written boundary description or map.

- Basic plant ecology knowledge is essential to determine resource values, and to establish management goals. Minimally, one team member must be familiar with vegetation of the area and be able to identify all the plant species. PNC can best be determined from ecological guides and through examination of protected areas that have not been grazed by livestock.

FIELD DATA COLLECTION

Field data collection is perhaps the most essential, but time consuming aspect of rangeland analysis. Data collected in the field is the basis for allotment management decisions as described in the Planning Chapter. Field data should be recorded on appropriate forms and noted on the field map or aerial photo. Field sampling will provide information on: range improvements, existing vegetation, desired plant communities, capability, and production.

RANGE IMPROVEMENTS

Existing range improvements within the area or allotment should be inspected and accurately located on aerial photos or appropriate field maps. Condition of the improvements should be noted, as well as future reconstruction needs.

EXISTING VEGETATION

Common Vegetation Units should be identified, mapped, and described according to IRI standards. There are seven delineation criteria for common vegetation units: physiognomic class, species, density, size, crown condition, vertical structure, and horizontal structure.

Field work adjusts and corrects CVU delineations based on what is actually found on-the-ground. Minimum unit size is not fixed. Small units may be extremely important if they produce large amounts of forage or provide important resource values. Unit size ultimately depends on the amount of information needed by the line officer to make an informed decision. The IRI Training Guide (U.S. Forest Service, 1995) provides additional information on delineation criteria and procedures.

Perhaps the most important field inventory task is to describe specific plant communities within the common vegetation units. Any method described in this chapter can be used to describe vegetation characteristics. Soil descriptions are an important part of understanding the analysis area, and evaluating and managing the resources. Use the appropriate inventory intensity indicated in Table 3-1. Temporary or permanent plots can be used, although permanent plots have far greater utility for wider application. Locate plots within representative key areas throughout the entire unit, as required. Accurately document plot locations on the field map or aerial photo.

DESIRED PLANT COMMUNITY

Desired plant community (DPC) selection is crucial to effective rangeland planning. The DPC has composition, structure, and function characteristics that best represent the desired condition specified in the Forest Plan. DPC is part of the overall desired condition and must be integrated with other features, for example, soil and visual characteristics. Identifying DPC is a collaborative process involving an interdisciplinary team. The team should document the reasoning behind the selection of desired plant communities. Forest Plans identify management areas with particular resource emphases. The role of rangeland analysis is to identify plant communities that provide high quality resource values for the management area.

Often existing plant communities comply with Forest Plan direction, providing a broad range of resource benefits. In these situations, allotment management objectives should maintain existing conditions.

In other cases, a different plant community may be more appropriate and better comply with the Forest Plan. The DPC should provide a broad range of values for all resources, but should be selected primarily for the management emphasis in the Forest Plan. Desired plant communities must currently exist in the general area in similar environmental settings, and are capable of occupying the site within a reasonable time period, through a management change.

It is not necessary to select the ultimate DPC that satisfies all Forest Plan and allotment objectives immediately. It is reasonable to identify a DPC that establishes the correct trend over the short-term, and then adjust the DPC later as the vegetation responds to the management change.[3] Effective documentation and communication of desired condition, desired plant community, allotment objectives, and their relationships will prevent confusion regarding short- and long-term objectives.

Many communities are difficult to change through normal management practices. For example, many bluegrass dominated sites exist due to prolonged, past overgrazing. It is often extremely difficult to convert them to a native bunchgrass community. Additionally, many sagebrush dominated communities evolved through a combination of management practices and natural succession. Neither situation can be corrected by simply changing the grazing management strategy. They require additional forms of disturbance to move the existing plant community towards the DPC. Objectives that convert the existing plant community to another community must be reasonable.

The inventory crew, or at least the crew leader, must be familiar with Forest Plan management areas. The inventory crew will describe vegetation and soil characteristics of the DPC. The IDT or rangeland manager will determine whether the existing vegetation is the DPC for each common vegetation map unit. Relict areas, research natural areas, and old exclosures or pastures may furnish valuable information.

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[3] In a few situations, DPC or a community displaying short-term objectives may not exist in the local area. Use of a composite set of biotic and abiotic chararctistics to define and describe allotment management objectives is encouraged.

RANGELAND CAPABILITY

Rangeland inventory identifies rangelands capable of supporting livestock grazing.

CLASSIFICATION OF RANGELAND CAPABILITY

Capable rangeland is accessible to livestock, produces forage or has inherent forage-producing capabilities, and can be grazed on a sustained basis under reasonable management practices. Accessible areas that produce forage as a result of timber management practices, fire, or other events may be classified as capable range. Such areas are often called transitory range even though forage may be produced ten or more years before natural or man-caused changes terminate it. Many prescribed burns, especially in tall shrub or timber types, create transitory range.

Rangeland meeting the above criteria, but not available for grazing because of land management decisions, is still classified as capable range. Such areas may be closed to grazing and the reason for closure indicated.

Capability maps often identify improved utilization opportunities. Capable rangeland should be identified and mapped based on:

- ♦ patterns of use by livestock under the existing management and range improvements, and
- ♦ expected changes in patterns of use resulting from specified changes in management and improvements.

Non capable rangeland includes areas where livestock grazing should not be planned because of unstable soil, steep topography, lack of management improvements, or inherently low potential for production. Some primary considerations are:

- ♦ Physical characteristics of the terrain such as steepness and length of slope and natural barriers.
- ♦ Soil and vegetation characteristics that may be classified as non capable (as determined by Forest Plan capability criteria) because of limitations such as:
  - Loose granitic soil on steep slopes.
  - Highly erosive soil from shale and mudstone.
  - Vegetative cover insufficient to protect the soil from erosion, where restoration would not be possible or practical under continued grazing use. Soil protection is not the sole criteria for determining capability. Rangelands may be in a depleted condition due to past use. They may provide little forage currently, but should be classified as capable if they meet all other criteria.
  - Boggy areas that prevent livestock use.
- ♦ Areas that are otherwise capable except for the lack of appropriate range improvements, such as water developments, fences, or vegetation manipulation.

STANDARDS AND GUIDES FOR CAPABILITY CLASSIFICATION

Written capability criteria must be prepared by an IDT in advance and approved by the appropriate line officer. Upon completion of field inventory, the approved capability criteria should be retained with the analysis data as a permanent record. Capability criteria shall be consistent with a site specific refinement of Forest Plan criteria. The following elements should be considered in developing capability criteria.

Site productivity should be evaluated in pounds of herbage and browse produced annually per acre. The minimum acceptable productivity is the level below which it would not be feasible or practicable to graze livestock. Lands that are not capable of producing at least 200 pounds total dry weight of forage per acre per year are usually classified as non capable and require no further consideration.

Soil stability is the inherent ability of soil to resist erosion. It depends on several factors, principally climate, erodibility, topography, and cover. These factors are used to evaluate erosion potential or erosion hazard. The following factors affecting soil stability may be considered in developing capability guides.

- Erodibility is the inherent tendency of soil to erode without consideration of climate, topography, or cover. It is based on:
    - the strength and size of the surface soil aggregates, and
    - profile characteristics, such as texture, depth to restrictive layer, and coarse rock fragments that affect infiltration, percolation, and storage of water.
- Slope gradient, length, roughness, shape, and aspect affect erosion hazard. Long slopes build up greater heads of water than short ones. Steep slopes are more subject to erosion by overland flow than are gentle slopes, because erosion capability increases as the rate of flow increases.
- Cover consists of vegetation, litter, and rock fragments. The amount, kind, and dispersion of cover determines its efficiency in protecting the soil from accelerated erosion.

Physical barriers include steep slopes, cliffs, brush, trees, down woody debris, rock, and other obstructions that restrict free movement of livestock. Range classified as non capable because of barriers should be reclassified if the obstructions no longer exist.

Management prescribes livestock kind and the management system, which may affect capability. A change from band herding to herderless fenced pasture sheep management may result in safe use of areas previously identified as non capable because of soil damage risks. Intensified management may result in the need to redefine capability criteria.

Interrelationships between factors such as soil stability, erosion, accessibility, slope, and distance to water determine capability. For instance, one mile to water on flat ground could be capable range, but one mile to water on a 40 percent slope might be non capable range.

APPLICATION OF INVENTORY DATA

The following is a discussion of some applications of inventory data. Other applications may arise in the future.

EVALUATION OF STATUS

There are two separate but related approaches in which inventory data can be used to evaluate status. First, is the evaluation of desired condition status based on the desired plant community. Second, is the determination of ecological status based on the potential natural community (Table 3-2). Rangeland management status, then, is the overall assessment of the effects of the allotment management plan.

In order to keep these approaches distinct, it is important to clearly understand ecological classification concepts. Specifically, knowing and understanding qualitative and quantitative differences between existing and potential natural communities, the nomenclature used to discuss them, and their application, is essential. Following is an explanation of the relationship between these concepts and a sample application of rangeland inventory data. Some variability in application will be required, dependent on the nature and quality of ecological classification products available.

DESIRED CONDITION STATUS

Evaluation of desired condition status and ecological status are somewhat similar. The difference is that existing vegetation data is compared to the desired plant community for desired condition status, while the same existing vegetation data is compared to the potential natural community for ecological status.

Figure 3-2 illustrates a hypothetical ecological type, with each circle representing a seral plant community that may occur in that type. Lines represent successional relationships. For instance, there is a direct successional relationship between PC6 and PC5. But there is no *direct* relationship between PC6 and PC3. Changes between two communities, consistent with the arrows, occur because of the presence or absence of disturbance. In addition, the rate of change is influenced by periodicity, intensity, and duration of disturbance events. Events may be natural, or the influence of management activities.

In this illustration, existing vegetative condition is represented by PC4 and the desired plant community is represented by PC3. Both communities are seral to the potential natural community, PC1. Desired condition status is the relationship, or similarity, between PC4 and PC3.

The evaluation of desired condition status provides the rangeland manager with a 'yardstick' for evaluating the similarity of existing vegetation to a desired plant community. Similarity is an evaluation tool normally applicable in the absence of an ecological classification.

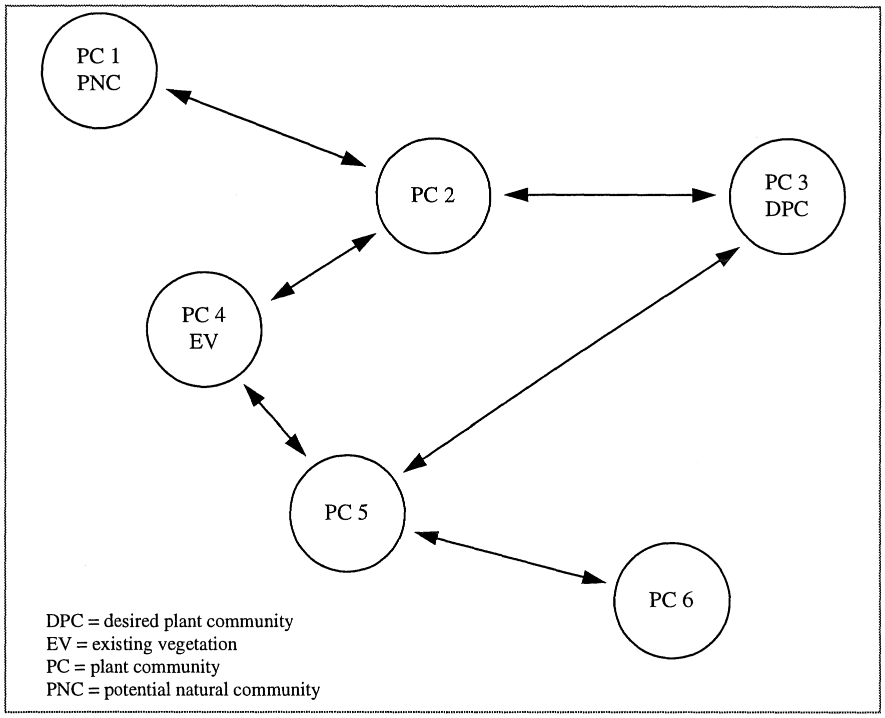
ECOLOGICAL STATUS

Ecological status is the degree of similarity between the existing plant community and the potential natural community. Ecological status cannot be accurately determined unless an ecological type classification exists and the potential natural community is known. Determination of ecological status is based on specifics of the ecological classification.

Table 3-2. DEFINITION OF STATUS IN RANGELAND ANALYSIS AND MANAGEMENT CONTEXT

Status	Definition
Desired Condition Status	Determination of the relative similarity between existing vegetation and the desired plant community (DPC)
Ecological Status	Determination of the relative similarity between existing vegetation and the potential natural community (PNC)
Rangeland Management Status	Determination of the relative success of rangeland management through desired condition status and trend

Figure 3-2. RELATIONSHIP OF POTENTIAL NATURAL COMMUNITIES AND SERAL COMMUNITIES


PC 1
PNC
PC 2
PC 3
DPC
PC 4
EV
PC 5
PC 6
DPC = desired plant community
EV = existing vegetation
PC = plant community
PNC = potential natural community

SIMILARITY COEFFICIENTS

Characteristics such as species composition and abundance, soil condition, and ground cover are considered in the evaluation. Using nomenclature from Figure 3-2, the following relationships exist.

$$\text{Desired Condition Status} \cong f\ (\text{EV, DPC})$$

$$\text{Ecological Status} \cong f\ (\text{EV, PNC})$$

Without an ecological classification it is difficult to determine a general or acceptable level of similarity for all types of communities. The inherent variability of natural communities can lead to difficulty in achieving high similarity values.

COVER-FREQUENCY INDEX

Similarity coefficients are computed on the worksheet provided (R2-2200-SC). The coefficients are a function of canopy cover and frequency. The result is the canopy cover-frequency index (CFI), similar to the index developed by Uresk (1990).

$$\text{Average Canopy Cover} \times \%\ \text{Frequency} = \text{CFI}$$

Using the index is inherently stronger than using either canopy cover or frequency by itself.

COMPUTING SIMILARITY COEFFICIENTS

Any inventory method (page 3-29) can be used to collect the data. Ocular plant composition and cover-frequency data are most often available. Use averaged canopy cover and frequency values from one or more cover-frequency transects. Use relative canopy cover, and constancy[4] from one or more ocular plant composition plots. The coefficient of community similarity is determined by using the following formula.

$$\frac{2w}{a+b}$$

where:

a	is the sum of values for measured parameters of existing vegetation,
b	is the sum of values for measured parameters in the desired plant community (desire condition status) or the potential natural community (ecological status), and

---

[4] Relative canopy cover is the sum of all cover values for a species from two or more ocular plant composition plots divided by the number of plots in which the species occurred. The following table illustrates. Constancy can be used as a surrogate for frequency.

	Plot 1	Plot 2	Plot 3	Relative Canopy Cover	Constancy	CFI
FETH	10	2		6%	67%	402
POPR	2	10	15	9%	100%	900
TAOF		5		5%	33%	165

w is the sum of the values for the measured parameters that are common to both.

The values summed for "*w*" are obtained by comparing the existing and desired values (or measures). The amount similar is the lesser of those two values for each species. "*w*" then is the sum of the similar portion for all species.

INTERPRETING SIMILARITY COEFFICIENTS

***As with any model developed for natural resource application, similarity coefficients* do not *provide black and white conclusions. Similarity coefficients* do *provide one evaluation of the similarity between two plant communities.* This point cannot be over-emphasized. *The allotment management plan resulting from rangeland analysis will be the composite product of many different pieces of information*.**

Therefore, the similarity coefficient is merely *one* guide or tool, by which the similarity of two plant communities can be evaluated. The break between similar and not similar desired condition status is established at 65 percent (Table 3-3).

Professional judgment and common sense are needed to interpret similarity data. This is especially true the closer the similarity coefficient is to 65 percent. Preliminary data analysis indicates that often a 60 percent similarity is acceptable for many community types. At this level of similarity many communities with the same dominant species will appear similar; for management and community description purposes they can be grouped together. Likewise, a 70 percent similarity may be not similar dependent on which species are present and which species are desired.

It is the responsibility of the rangeland manager to interpret similarity coefficient results and to thoroughly document whether the similarity evaluation is accurate or not. ***Application of similarity coefficients is inherently risky without a more complete understanding of the vegetation community relationships and ecological significance of specific plant species.*** Identifying and describing these components is one objective of ecological type classifications.

Table 3-3. DESIRED CONDITION STATUS

Similarity Coefficient	Desired Condition Status
65-100%	Similar to the desired plant community
0-64%	Not similar to the desired plant community

RANGELAND MANAGEMENT STATUS

Rangeland management status can be described by combining desired condition status with trend determinations. For example, a plant community with a similar desired condition status and a trend "away from" management objectives would be considered in unsatisfactory rangeland management status (Table 3-4). Likewise, a not similar desired condition status with a trend "towards" objectives might be considered in satisfactory rangeland management condition. Trend determination is described on page 3-23.

Table 3-4. INTERPRETING RANGELAND MANAGEMENT STATUS FROM DESIRED CONDITION STATUS AND TREND

TREND	DESIRED CONDITION STATUS	
	Not Similar	Similar
Toward	Satisfactory	—
Static	Unsatisfactory	Satisfactory
Away From	Unsatisfactory	Unsatisfactory

SIMILARITY COEFFICIENT (R2-2200-SC)

Forest **Headwaters**	District **Red Cloud**	Plot ID **FS 02 12 10 373010830 0045 94**
Allotment Name and Number **Turret Peak**		Pasture **Pat Park**
Year of Study **1993**	Date **6/25/93**	Examiner(s) **MJB**
Potential Natural Community **ARTRV/FEID/Agric Cryoborolls**	Existing Plant Community **ARTRV/FEID**	Method of Measurement **Cover-Frequency Transect**

SPECIES	Canopy Cover-Frequency Index by Species Present	DPC	Similar	NOTES
POTR5		**100**		
SABE2		**500**		
ARTRV	**293**	**250**	**250**	
SYOR2	**1**	**75**	**1**	
CHNA2	**353**			
CHVI8	**10**			
RILA		**80**		
SARA2		**50**		
FEID	**170**	**500**	**170**	
CAEL3	**7**	**100**	**7**	
POPR	**520**	**100**	**100**	
PONE2	**1500**	**750**	**750**	
CAGE2		**100**		
KOMA	**7**	**50**	**7**	
CAFI	**1**			
KOCR	**8**			
PASM	**25**			
BROMU	**115**	**25**	**25**	
ELEL5	**1**			
ACLA5	**1083**	**700**	**700**	
TAOF	**1327**	**500**	**500**	
MEFU2	**180**	**250**	**180**	
LATHY	**323**	**100**	**100**	
VIAM	**110**	**75**	**75**	
DEBA2	**110**	**75**	**75**	
RAGL	**11**	**25**	**11**	
NOMO2	**11**	**25**	**11**	
ANSE4	**10**			
GASE6	**10**			
ERIOG				
PHMU3	**1**			
ANAM	**1**			
	(a)	(b)	(w)	
TOTAL	**6188**	**4430**	**2962**	
Similarity Coefficient (%)			**56%**	$\frac{2w}{a+b}$ = % Similar
Desired Condition or Ecological Status			**Not similar**	

SIMILARITY COEFFICIENT (R2-2200-SC)

	Canopy Cover-Frequency Index by Ground Cover Categories			
SPECIES	Present	DPC	Similar	NOTES
WOOD	**18**	**50**	**18**	
LITTER/DUFF	**4200**	**6000**	**4200**	
MOSS/LICHEN	**325**	**200**	**200**	
BASAL VEG	**200**	**400**	**200**	
WATER	**0**	**0**	**0**	
BARE SOIL	**3300**	**1000**	**1000**	
GRAVEL	**180**	**150**	**150**	
COBBLE	**25**	**30**	**25**	
STONE	**20**	**20**	**20**	
BOULDER	**1**	**0**	**0**	
ROCK	**0**	**0**	**0**	
	(a)	(b)	(w)	
TOTAL	**8269**	**7850**	**5813**	
Similarity Coefficient (%)			**72%**	$\frac{2w}{a+b}$ = % Similar
Desired Condition or Ecological Status			**Similar**	

RESOURCE VALUE RATINGS

A resource value rating (RVR) is the quantification of a particular use or benefit for an ecosystem. RVRs are part of the characterization of an ecological type and associated seral communities in an ecological classification. They can be determined for any plant community as long as the coefficients associated with individual species or combinations of species is known. RVRs must be set within the capability context of the plant community and can be quantitative or qualitative, expressed with adjective ratings such as low, moderate, and high.

RVRs are usually developed for individual plant species.[5] This approach must be extended to assemblages of plant species. In this fashion, RVRs can be developed for each plant community and be better suited for ecosystem management application. The RVR list should be developed at the Forest, or possibly District, level through an interdisciplinary process, and supplemented as the ecological classification is done. The following is an example of RVRs.

> A desired plant community in a mountain allotment is the Big Sagebrush - Idaho Fescue (ARTR2-FEID) plant community. The resource value ratings determined by the local District staff for that plant community are:

Resource of Interest	Resource Value Rating
Forage for cattle	High (during summer)
Forage for sheep	Low
Forage for deer	Moderate
Nesting habitat for ground birds	High
Water quality	High

SOIL RATINGS

Erosion rates are difficult to directly measure. Erosion hazard is related chiefly to effective vegetation, litter, and other ground covers. Ground cover is determined from cover-frequency or rooted nested frequency sampling methods. Minimum quantities of vegetation and litter cover to prevent excessive soil erosion should be established for each ecological type by evaluating areas representative of natural erosion rates. These comparisons or standards will be adjusted for slope and aspect. Soil ratings may be expressed as the ratio between vegetation/litter cover on the site and vegetation/litter cover for the ecological type.

DETERMINING INITIAL GRAZING CAPACITY

In most of the western United States, grazing has occurred for many years and grazing capacity estimates have been adjusted based on actual use observations (see page 4-9). However, in those instances where initial capacity needs to be determined (new allotment or reactivation of vacant allotments) the following procedure can be followed (see R2-2200-GA).

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[5] See Appendix L

1. Determine total forage production on each common vegetation unit considered to be capable range (see page 3-75).
2. Multiply pounds per acre in each common vegetation unit by proper use factor (a maximum of 40-45 percent for initial stocking rates) and the number of acres. This amount is available forage.
3. Total the available forage production for all map units.
4. Divide available forage by the daily dry weight consumption rate (Table 3-5) for the kind and class of livestock permitted.
5. Divide by 30 days/month to calculate estimated capacity in AUMs.
6. The estimated capacity *must* be checked against stocking rates on nearby allotments with similar characteristics and objectives before use is permitted. Initial capacity estimates should be conservative, allowing for the many other uses and values on public land.
7. Monitor actual use; adjust stocking as needed to meet objectives.

Livestock weights are average mid grazing season weights. Length of time on National Forest or Grassland range, breed of livestock, and when the animal is born can result in figures different from the averages listed. Big game values are fall-season averages.

Table 3-5. DAILY FORAGE CONSUMPTION RATES

Livestock Kind and Class	**Animal Unit Factor**	**Daily Dry Weight Consumption**	
		lbs	**kg**
Cattle[6]			
1000-lbs (454 kg) animal	1.000	26	11.79
Dry cow	1.000	26	11.79
Cow with calf	1.308	34	15.42
Yearling	0.692	18	8.16
Weaner	0.500	13	5.90
Bull	1.500	39	17.69
Bison	1.000	26	11.79
Horse	1.192	31	14.06
Sheep			
125-lbs (57 kg)	0.192	5	2.27
Ewe with lamb	0.308	8	3.63
Big Game[7]			
elk 430-lbs (195 kg)	0.462	12	5.44
deer 135-lbs (61 kg)	0.173	4.5	2.04

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[6] Valentine, John F. Nutrient Requirements of Beef Cattle, Fifth revised edition. Committee on Animal Nutrition, National Academy of Sciences -- National Research Council. San Diego, CA: Academic Press, Inc. 1990.

[7] Personal communications: Colorado State University and Colorado Division of Wildlife Research Unit personnel.

GRAZING ALLOTMENT SUMMARY and LIVESTOCK CAPACITY ESTIMATE
(R2-2200-GA)

Forest **GM/UNC/GUNN NF**	1. Gross area of allotment	**10,723**
District **TAYLOR RIVER RD**	2. Alienated land, no capacity estimate	**--**
Allotment Name and Number **RED CREEK**	3. Total area open (#1 - #2)	**10,723**
Kind and/or Class of Animal **C/C**	4. Non capable area (N)	**2,115**
Allowance (lb/day/animal -- dry wt.) **34#/DAY**	5. Closed to livestock use	**--**
Field Work Completed (Date) **93/08/01**	6. Total area unusable (#4 + #5)	**2,115**
Examiner: **J. POPE**	7. Total open and usable (#3 - #6)	**8,608**
Summary Completed (Date) **94/02/15**	8. Alienated land open and usable	**--**
By: **J. POPE**	9. NFS land usable and open (#7 - #8)	**8,608**
	10. Estimated Carrying Capacity (AUM) (from back)	**1,578**

OBLIGATION AND RATE OF STOCKING: Permits and Past Actual Use

	Animal Kind	Animal Class	Animal Numbers	Season	Animal Months	Animal Unit Months
Term Permit	**CATTLE**	**C/C**	**320**	**6/15-10/15**	**1280**	**1664**
Permit						
Permit						
Permit						

Year	19 **87**	19 **88**	19 **89**	19 **90**	19 **91**	19 **92**	19 **93**	19____	19____
Number of Animals	**320**	**320**	**185**	**320**	**320**	**320**	**320**		
Season of Use	**6/15-10/15**	**6/15-10/15**	**6/15-10/15**	**7/1-10/15**	**6/15-10/15**	**6/15-10/15**	**6/15-10/1**		
Animal Months	**1280**	**1280**	**740**	**1120**	**1280**	**1280**	**1120**		

Attach analysis tabulations, calculations, and reports showing condition class, and maps. Make cross-reference to or include other data such as range inspections, administrative studies, climatic records, research publications, periodic utilization checks, production studies, and plant development measurements.

Miscellaneous information (recommendations: special problem areas, relationship to Forest Plan, etc.)

Map Label	Acres	Trend	Resource Value Rating	Forage Allowable Use %	Forage Production (dry lb/ac)	Est. Carrying Capacity (AUM)
6CS ABLA-PIEN	**1205**	↔		**10%**	**300**	**35**
6NS ABLA-PIEN	**2115**	↔		**--**	**--**	**--**
10CS POTR5	**1640**	↔		**40%**	**450**	**289**
4CS QUGA/POPR	**1278**	↔		**30%**	**500**	**188**
4CN ARTR2/POPR	**1680**	↓		**30%**	**525**	**259**
2CN POPR/TAOF	**518**	↓		**30%**	**400**	**61**
2CS DECE-CANE2	**285**	↔		**45%**	**925**	**116**
2CN POPU9/DECE	**113**	↔		**30%**	**900**	**30**
2CS SAGE2/CARO5	**135**	↔		**45%**	**1175**	**70**
2CS CANE2	**92**	↔		**45%**	**925**	**38**
1CS FETH-FEID	**625**	↔		**45%**	**750**	**207**
1CS FETH-STLE4	**820**	↔		**35%**	**725**	**204**
1CS DAIN	**217**	↔		**45%**	**850**	**81**
Totals	**10,723**					**1,578**

TREND DETERMINATIONS

Trend is basically a measure of management's effectiveness in meeting allotment objectives for desired plant communities. Trend is described as toward, static, or away from objectives. Trend determinations are a key part of rangeland monitoring. An in-depth discussion of trend determinations can be found in the Monitoring Chapter.

Field data collection should include re-sampling permanent trend plots. Trend should be estimated from either permanent plots or a recording of apparent trend based upon the observer's professional opinion. It is important to document whether trend determinations were measured or estimated. Major management changes involving considerable investments of time, funding, or livestock adjustments should be based primarily on measured trend studies at permanent locations.

ALLOTMENT MAP STANDARDS

There are two maps used in rangeland inventory and analysis: the inventory map and the allotment map. Gradually, the inventory map will be replaced by IRI maps.[8] Allotment maps are updated with every reanalysis of the grazing allotment. Some units have the necessary GIS technology to produce their own allotment maps. Where this technology exists, Forests should follow, as closely as possible, the guidelines for legends and labeling in this chapter. On those units without GIS technology, final allotment maps will be prepared according to the following standards.

Allotment maps throughout the Region will be similar in design, content, and appearance. Consistency can be obtained by utilizing the Regional Geometronics Photo Lab or a private contractor to prepare the base maps. Analysis information can be drafted onto the base maps by the person(s) completing the analysis. The following steps should be followed in the preparation of the base map:

1. Allow approximately three months for the preparation of the base map. Contact the Lab Director (303-275-5338) or private contractor prior to ordering maps; establish time frames, map content, and costs. This contact is extremely important to insure that the Lab understands your needs and expectations.
2. Complete a Photographic Work Requisition (FS-7100-41) and submit it to the Photo Lab. This form should contain a short narrative requesting preparation of an allotment base map to regional standards. Any special instructions or expectations should be included in the narrative. Attached to the requisition should be:
    - ♦ Forest Recreation Map or standard USGS Quad Map with the allotment boundary delineated. The area outside the allotment to be included in the base map should also be delineated. A completed FS-7100-41 follows and Figure 3-3 shows the associated map.

---

[8] Common vegetation, land, and water units

FORM FS-7100-41

USDA-FOREST SERVICE

PHOTOGRAPHIC WORK REQUISITION

Instructions: Prepare field orders in accordance with local instructions. See FSM 7140 for orders to W.O.

CHARGE TO *(Unit)*: Red Cloud RD Headwaters NF
APPROPRIATION AND PROJECT: MC:664287
SEND TO: R-2 GEOMETRONICS Photo Lab
ADDRESS: 740 Simms Lakewood, Co 80225
DATE DESIRED: 4/1/94
ORDERED BY *(Signature)*:
TITLE: Support Services Supervisor
ORDER DATE: 12/15/93
FOR INFORMATION *(Name & Phone No.)*: M.Bovine 303-287-2635
ORDERING OFFICE REFERENCE *(What & Date)*:
REQUISITION NO. 65

CLASS OF WORK	NO. COPIES DESIRED	SCALE	NEGATIVE NUMBERS, DESCRIPTION OF WORK AND SPECIAL INSTRUCTIONS	NEG./ORIG. SENT	NEG./ORIG. RETURNED
Aerial index					
Aerial mosaic					
Aerial photo *(Contact-Enlargement)*					
Autopositive					
Blue-line prints					
Blueprints					
Color proof					
Contact prints					
Diapositive plates					
Diazo					
Diazo reproducibles					
Duplicate slides *(35 mm)*					
Enlargements					
Field photography					
Film developing					
Film positives	1	1:24000	This requisition is for the preparation of a Matte Film Positive of the Turret Peak C&H Allotment. Attached is a Forest Map of the area to be included on the positive. Also attached are the topographic map positives to be used in constructing the Matte Film Positive. Please return these topo map positives upon completion.		
Line film					
Map mosaic					
Microfilm print					
Mounting					
Multilith					
Opaque plastic prints					
Paper negative					
Photostat prints					
Polyester					
Reductions					
Scribe coating					
Solar bromide prints					
Transparencies					
Vandyke neg. or pos.					
Watercote					

Photographic Laboratory Record

DATE PROMISED
DATE SENT

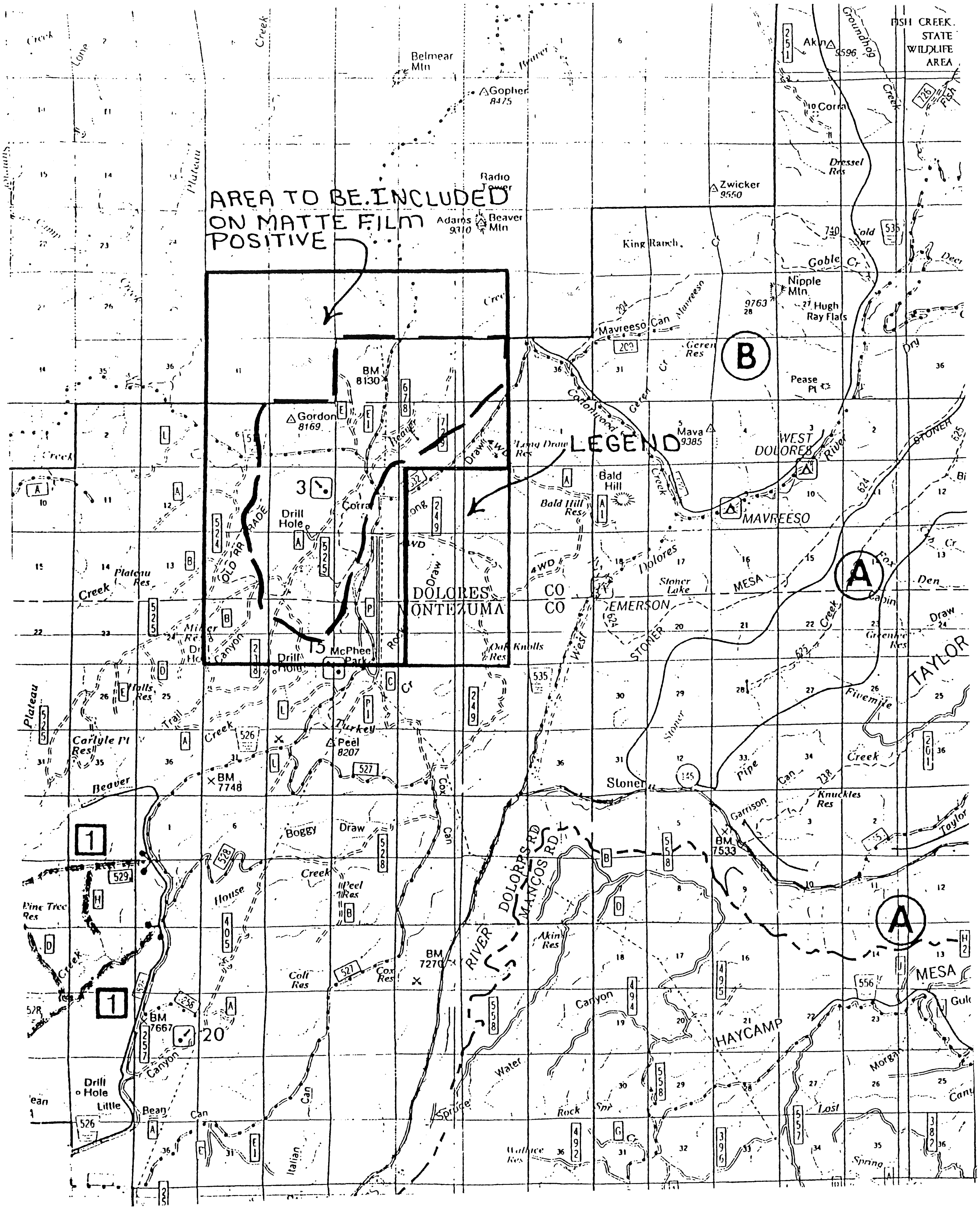
CLASS OF WORK	NO. COPIES	TOTAL NO. COPIES	SIZE	UNIT COST	TOTAL COST	MONTH BILLED

Accounting Data for Use by Ordering Office

ESTIMATED OBLIGATION:

APPN. *(F. S.)*	STATE	ACCOUNT OR ACTIVITY	FUNCTION Major	FUNCTION Sub.	FUNCTION Exp.	PROJECT	SPECIAL LIMITATION	OBJECT CLASS Major	OBJECT CLASS Sub.	OBJECT CLASS Rate	AMOUNT

Figure 3-3. SAMPLE MAP


AREA TO BE INCLUDED ON MATTE FILM POSITIVE
LEGEND
Belmear Mtn
Gopher 8475
Radio Tower
Adams 9310
Beaver Mtn
Zwicker 9550
Akin 9596
FISH CREEK STATE WILDLIFE AREA
Groundhog
Dressel Res
King Ranch
Goble Cr
Nipple Mtn
Hugh Ray Flats
Mavreeso Can
Geren Res
B
Pease Pt
BM 8130
Gordon 8169
Mava 9385
WEST DOLORES River
MAVREESO
Bald Hill
Bald Hill Res
Drill Hole
Corral
OLD RR GRADE
DOLORES
MONTEZUMA
CO
CO
EMERSON
Stoner Lake
MESA
A
STONER
Oak Knolls Res
McPhee Park
Miller Res
Halls Res
Plateau Creek
Carlyle Pt Res
Turkey
Peel 8207
BM 7748
Stoner
TAYLOR
Fivemile
Knuckles Res
Garrison
BM 7533
Boggy Draw
House Creek
Peel Res
DOLORES RD
MANCOS RD
RIVER
Akin Res
BM 7270
Cox Res
Coll Res
BM 7667
1
1
20
3
15
Pine Tree Res
A
MESA
HAYCAMP
Canyon
Water
Spruce
Rock
Lost
Spring
Morgan
Drill Hole
Little Bean Can
Italian
Wallace Res

- Topographic map positives at the standard 1:24,000 scale for each USGS quadrangle within the allotment. Topographic positives are available on most Districts and in all Supervisor's Offices. Positives will be returned to the requesting unit when the map is complete.
- The Photo Lab has the standard regional map symbols legend for the title block[9] that will be attached to every map (Figure 3-4). Additions or deletions to the Regional legend should be made by the ordering unit and submitted to the Lab. A title block should also be prepared by the ordering unit and submitted with the requisition. All additions to the legend and the title block should be prepared with the same quality and format as the exhibits.

3. The Photo Lab or contractor will prepare a negative and a matte film positive of the allotment. The negative will be kept by the Photo Lab for future use and the positive returned to the requesting unit. The positive will be used as the base map upon which analysis information is drafted. Analysis information can be drawn on the positive itself, or drafted on overlays. Allotment maps can be produced for field use on several types of copy machines. Figure 3-5 shows an example of a complete standard allotment base map.
4. For ease of map interpretation, the final allotment map will be colored using the standard rangeland cover type colors as defined on page 3-27.

ALLOTMENT MAP LEGEND

If IRI is complete for the analysis area, then rangeland inventory will validate, refine, and update the CVU layer. Identified changes must be coordinated through the Forest IRI leader and will be incorporated directly into the electronic CVU layer.

If the CVU layer is not developed for the allotment(s) being inventoried, then rangeland inventory will follow Integrated Resource Inventory protocol (U.S. Forest Service, 1995) as closely as possible. The intent is to develop a map that will facilitate the IRI process later. These guidelines are intended to serve during the transition period between traditional rangeland analysis and implementation of new GIS and IRI technologies.

In either case, it is likely that information above and beyond that available through the CVU layer will be required on the allotment map. The allotment map must be useful to resource managers and permittees alike, at the project level. Several important pieces of information often included on the map are listed below. The first six (cover type, range capability, desired condition status, common vegetation unit, acres, and trend) are the minimum attributes required to adequately label the range allotment map. Two additional items that may be added to the map label, if available, are ecological type and ecological status.

---

[9] Map legend must be provided for private contractors.

Figure 3-4

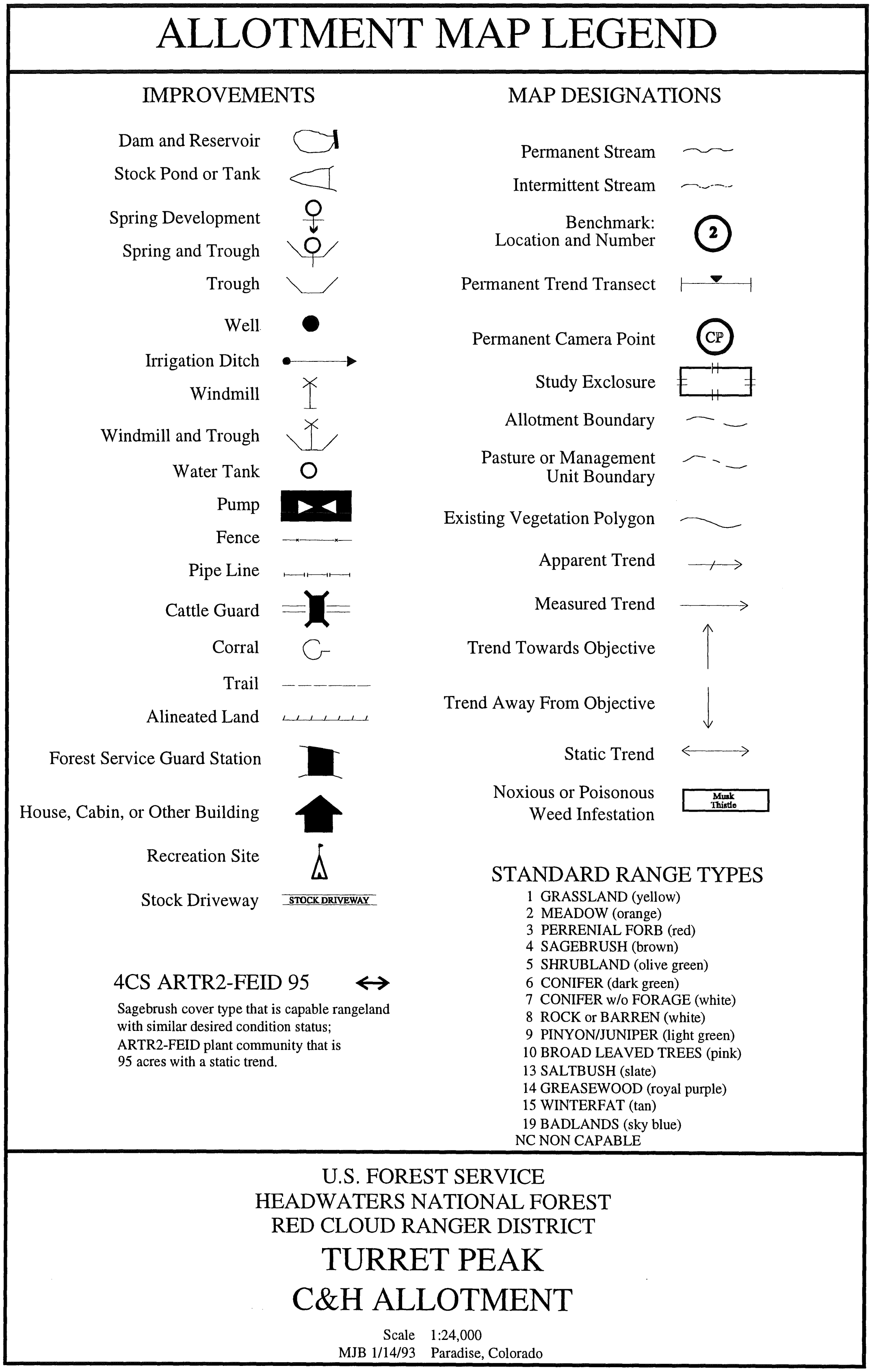
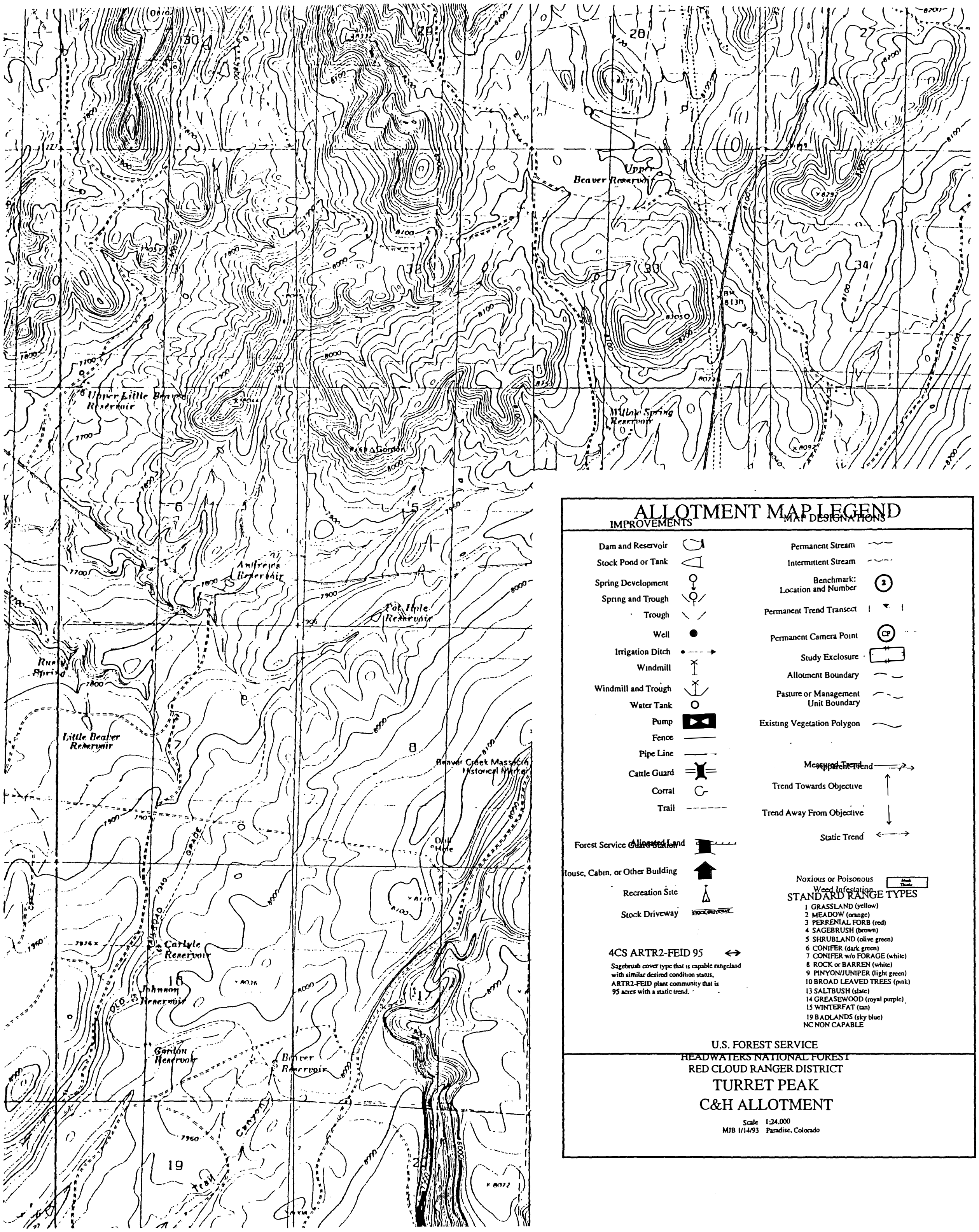

ALLOTMENT MAP LEGEND
IMPROVEMENTS
Dam and Reservoir
Stock Pond or Tank
Spring Development
Spring and Trough
Trough
Well
Irrigation Ditch
Windmill
Windmill and Trough
Water Tank
Pump
Fence
Pipe Line
Cattle Guard
Corral
Trail
Alineated Land
Forest Service Guard Station
House, Cabin, or Other Building
Recreation Site
Stock Driveway
STOCK DRIVEWAY
4CS ARTR2-FEID 95
Sagebrush cover type that is capable rangeland with similar desired condition status; ARTR2-FEID plant community that is 95 acres with a static trend.
MAP DESIGNATIONS
Permanent Stream
Intermittent Stream
Benchmark: Location and Number
2
Permanent Trend Transect
Permanent Camera Point
CP
Study Exclosure
Allotment Boundary
Pasture or Management Unit Boundary
Existing Vegetation Polygon
Apparent Trend
Measured Trend
Trend Towards Objective
Trend Away From Objective
Static Trend
Noxious or Poisonous Weed Infestation
Musk Thistle
STANDARD RANGE TYPES
1 GRASSLAND (yellow)
2 MEADOW (orange)
3 PERRENIAL FORB (red)
4 SAGEBRUSH (brown)
5 SHRUBLAND (olive green)
6 CONIFER (dark green)
7 CONIFER w/o FORAGE (white)
8 ROCK or BARREN (white)
9 PINYON/JUNIPER (light green)
10 BROAD LEAVED TREES (pink)
13 SALTBUSH (slate)
14 GREASEWOOD (royal purple)
15 WINTERFAT (tan)
19 BADLANDS (sky blue)
NC NON CAPABLE
U.S. FOREST SERVICE
HEADWATERS NATIONAL FOREST
RED CLOUD RANGER DISTRICT
TURRET PEAK
C&H ALLOTMENT
Scale 1:24,000
MJB 1/14/93 Paradise, Colorado

Figure 3-5. ALLOTMENT MAP (SCALE 1:24,000)


30
29
28
Upper Beaver Reservoir
31
32
33
34
Upper Little Beaver Reservoir
Willow Spring Reservoir
Gordon
6
5
Antifreeze Reservoir
Pot Hole Reservoir
Rush Spring
Little Beaver Reservoir
7
8
Beaver Creek Massacre Historical Marker
Carlyle Reservoir
18
Johnson Reservoir
17
Gordon Reservoir
Beaver Reservoir
Canyon
19
20
Trail
ALLOTMENT MAP LEGEND
IMPROVEMENTS
Dam and Reservoir
Stock Pond or Tank
Spring Development
Spring and Trough
Trough
Well
Irrigation Ditch
Windmill
Windmill and Trough
Water Tank
Pump
Fence
Pipe Line
Cattle Guard
Corral
Trail
Forest Service Guard Station
Alienated Land
House, Cabin, or Other Building
Recreation Site
Stock Driveway
MAP DESIGNATIONS
Permanent Stream
Intermittent Stream
Benchmark: Location and Number
2
Permanent Trend Transect
Permanent Camera Point
CP
Study Exclosure
Allotment Boundary
Pasture or Management Unit Boundary
Existing Vegetation Polygon
Measured Trend
Apparent Trend
Trend Towards Objective
Trend Away From Objective
Static Trend
Noxious or Poisonous Weed Infestation
Musk Thistle
4CS ARTR2-FEID 95
Sagebrush cover type that is capable rangeland with similar desired condition status, ARTR2-FEID plant community that is 95 acres with a static trend.
STANDARD RANGE TYPES
1 GRASSLAND (yellow)
2 MEADOW (orange)
3 PERRENIAL FORB (red)
4 SAGEBRUSH (brown)
5 SHRUBLAND (olive green)
6 CONIFER (dark green)
7 CONIFER w/o FORAGE (white)
8 ROCK or BARREN (white)
9 PINYON/JUNIPER (light green)
10 BROAD LEAVED TREES (pink)
13 SALTBUSH (slate)
14 GREASEWOOD (royal purple)
15 WINTERFAT (tan)
19 BADLANDS (sky blue)
NC NON CAPABLE
U.S. FOREST SERVICE
HEADWATERS NATIONAL FOREST
RED CLOUD RANGER DISTRICT
TURRET PEAK
C&H ALLOTMENT
Scale 1:24,000
MJB 1/14/93 Paradise, Colorado

A sample allotment inventory map unit label will look like:

4CS ARTR2-FEID 95 ↔

This indicates a sagebrush-Idaho fescue cover type that is capable rangeland with similar desired condition status. It is the ARTR2-FEID plant community type, and the 95 acres in the map unit have a static trend with respect to meeting management objectives.

STANDARD RANGELAND COVER TYPES

Use the following number and color codes to indicate rangeland cover types. Labeling and coloring the map may be done by hand, at present. In the future, GIS technology will produce maps with the same numbering and coloring conventions. Or, the conventions may be easily modified, as warranted.

1.	Grassland	yellow
2.	Meadow	orange
3.	Perennial forb	red
4.	Sagebrush	brown
5.	Browse -- mountain shrub	olive green
6.	Conifer	dark green
7.	Conifer without forage	[no color]
8.	Rock or barren	[no color]
9.	Piñon juniper	light green
10.	Broad-leaved trees	pink
13.	Saltbrush	slate
14.	Greasewood	royal purple
15.	Winterfat	tan
19.	Badlands	azure-sky blue

RANGE CAPABILITY

Range capability is expressed as either:

C (capable), or

N (non capable).

DESIRED CONDITION STATUS

Desired condition status is expressed as either:

S (similar), or

N (not similar).

COMMON VEGETATION UNIT

There are two naming conventions of which one or both may be used on the allotment map.

1. The map unit legend will be as described in the Common Vegetation Unit Chapter of the IRI Training Guide, including physiognomic class, species, size, density, crown condition, vertical structure, and horizontal structure.
2. In the absence of a Common Vegetation Unit map, a plant community name may be used. The name is usually two (sometimes three) species, with usually one identified per layer, that are usually the most abundant in the existing vegetation. For example, *Artemesia tridentata—Festuca idahoensis* (ARTR2-FEID). The source of the community name is an ecological classification. Without a classification, it is advisable to omit this information.

ACRES

The number of acres included in the map unit.

TREND

Use the following symbols to indicate trend.

Trend	Symbol
Toward	↑
Static	↔
Away From	↓
Not Apparent	?

ECOLOGICAL TYPE

Ecological types are commonly named with a two-part name including abiotic and biotic information. The abiotic portion is based on physical features such as landform or soil family. The biotic name consists of two (sometimes three) scientific names of characteristic, prominent, or diagnostic species. Ecological types are identified and described only through thorough statistical analysis of biotic and abiotic data. Only then can a name be assigned to an ecological type. The source of the name is an ecological classification. Without a classification, it is advisable to omit this information because the most abundant species are not always reflected in the name. (The Common Land Unit map legend may be alternatively used instead of the ecological type name.)

ECOLOGICAL STATUS

Ecological status is indicated by PNC, LS, MS, or ES, or the appropriate scorecard rating as described in the classification.

INVENTORY METHODS

There are three categories of information collection methods related to rangeland inventory. First is regionally standard inventory methods for collecting information about and describing vegetative characteristics. Second is descriptive site data, ***which is required*** for all inventory and monitoring samples. Third is additional methods that may be developed locally.

The most frequently used methods for vegetative inventory in the Rocky Mountain Region, in order of increasing intensity, are ocular plant composition, cover-frequency, and line intercept. Data collected by these methods can be used for:

- classification of ecological types,
- community type descriptions,
- predicting vegetation response to treatment,
- developing resource value ratings,
- calculating similarity to desired plant community or to potential natural community, and
- monitoring change over time (except for ocular plant composition method).

STANDARD INVENTORY METHODS

OCULAR PLANT COMPOSITION METHOD (OP)

This method allows the examiner to more thoroughly inventory all portions of a polygon. The sample is usually a 0.10 acre or 0.20 acre circle, with canopy cover estimates for each species present. The General Field Form ***must*** be completed for each sample, or cluster of samples. The ocular plant composition method is described in Exhibit OP. This method is identical to the process used by IRI.

COVER-FREQUENCY METHOD (CF)

This is the primary rangeland inventory method used in this Region. It provides both canopy cover and frequency of occurrence data for plant species. The sample is a ***pair*** of 100-foot parallel transects at least 50 feet apart with canopy cover measures developed from twenty Daubenmire plot frames placed at 5-foot intervals along each transect line. The General Field Form ***must*** be completed for each transect pair. Permanently established cover-frequency samples can be used for long-term monitoring. The cover-frequency method is described in Exhibit CF.

LINE INTERCEPT METHOD (LI)

This method is used to more accurately estimate canopy cover of shrub species, and to collect information on maturity and form classes for individual shrub plants, as well as the degree of hedging. The sample is a ***pair*** of 100-foot parallel transects at least 50 feet apart with actual occurrence of foliar shrub cover measured to the nearest 0.10 foot using the same transects from cover-frequency. Permanently established line intercept samples can be used for long-term monitoring. Line intercept is an extremely valuable method for inventorying big-game wither ranges and rangelands dominated by a shrub component. The General Field Form ***must*** be completed for each sample. The line intercept method is described in Exhibit LI.

PRODUCTION DATA (PD)

A key element of initial inventory is collection of vegetative production data. Production information is useful for making general decisions regarding plant community health and vigor. Additionally, production is a necessary element in determining carrying capacity for grazing animals. The production data method is described in Exhibit PD.

PARKER THREE-STEP METHOD

The Parker three-step method is not an approved method in the Rocky Mountain Region. However, as many existing Parker transects as possible should be converted to cover-frequency transect data. Evaluate each location of Parker three-step transect clusters, and if appropriate, re-read, then sample again with a cover-frequency transect, to complete their conversion. See Exhibit Parker for a more complete discussion of converting Parker transects.

DESCRIPTIVE SITE DATA

GENERAL FIELD FORM (GF)

This form is required as an integral part of data collection, regardless of inventory or monitoring method used. This form must be completed for all samples, or cluster of samples: temporary and permanent.

Fields are indicated as required or optional based on rangeland analysis and other applications. General field data has wide utility to many applications, not just rangeland inventory and analysis. It can be used to stratify District, Forest, and Regional data bases, as well as a basis for extrapolating information with confidence to other sites. It also provides ground-truthing information for IRI. The absence of general field data weakens the utility of the data for other purposes. The General Field Form is described in Exhibit GF.

Normally, a General Field Form must be completed for each and every sample. The exception where one General Field Form can be used for several plots is when more than one transect for cover-frequency and/or line intercept are clustered together — similar to the way Parker three-step transects were clustered.

RANGELAND HEALTH EVALUATION MATRIX (RH)

This form is used to generally characterize the health of the rangeland (National Research Council, 1994). It is useful in orienting the examiner's eye towards characteristics and features that are important in managing rangeland ecosystems. This form is normally completed as part of every sample. The rangeland health evaluation matrix is described in Exhibit RH.

COMMENTS DATA FORM (CD)

This form is used to record any comments for a plot, transect, or polygon as the need arises. Important observations not recorded on other forms should be noted. Clarification of non standard conditions or data codes is documented on this Form. The Comments Data Form is described in Exhibit CD.

OTHER METHODS

Other inventory methods may be employed in addition to the standard region-wide methods for vegetative inventory listed above. Forests are encouraged to adopt statistically sound methods. For example, Uresk (1990) describes a technique using discriminate and cluster analysis for classifying rangeland ecosystems into ecological stages on the basis of cover and frequency estimates of only a few vegetation species.

Currently there is an on-going interagency project to develop a series of inventory and monitoring technical guides for use by all agencies. These technical guides will include methods in this guide, plus additional methods for use in specific locations and situations in the western United States. Methods in these interagency technical guides are approved for use in the Rocky Mountain Region. The technical guides are scheduled to be available in the near future.

In order for another method to be used, it must be published and subjected to peer review, and be approved by the Regional Forester.

TIMING OF SAMPLING

Installation, measurement, and remeasurement of all samples should be timed to coincide with maximum phenological development. This helps in plant identification and also reduces variation in canopy cover estimates. Where possible sample prior to grazing. When planning remeasurements bear in mind the stage of phenological development rather then calendar dates.

LOCATION OF TRANSECTS

The objective of proper transect location is to randomly select a site that is representative of existing conditions or of the desired plant community. Sample plots must be located within definite boundaries of the common vegetation unit to be described. They must be placed on representative and uniform sites so that ecotones are avoided.

Temporary transects should be located in the key area based upon the professional judgment of the rangeland manager. For permanent transects to be used for trend measurements for many years, special care must be taken to eliminate bias in location. It is advisable to utilize a grid system in locating the benchmark where the transect will be located.

NUMBER OF TRANSECTS

Regardless of the method(s) selected for conducting the inventory, the examiner will have to rely on common sense, professional judgment, and statistical reliability to determine the number of transects required to adequately describe the common vegetation unit. Reference Appendix C for the procedure to determine the appropriate number of transects necessary to describe the variability of the site. Parameters such as intensity, controversy, and the magnitude of the decision to be made will help determine the number of sample sites.

It is preferable to record more transects than to increase the number of sample points on a single transect. This is especially critical in sparse vegetation or plant communities that are patchy in occurrence. After completion of the first transect and use a species-area curve to determine whether the site is adequately sampled. If more transects are needed, be sure they are at least 50 feet apart and parallel, if possible.

ESTABLISHING TRANSECTS

Permanent or temporary transects can be used with all sampling methods. ***Regardless of transect duration, permanent or temporary, all plot or transect locations must be marked on maps and/or aerial photographs.*** Transect locations should be sufficiently described for easy relocation, including road or trail log, reference point description, distance and bearing to the plot from the road or trail, and plot center description. The location should be labeled with the plot number.

Temporary transects are adequate for most inventory purposes, but permanent transects are recommended for benchmark areas where trend of the ecological unit will be monitored over time. Temporary transects are established identical to permanent transects except there are no permanent stakes. ***Paced transects are not approved for collecting vegetation canopy cover and frequency data.***

A common problem related to permanent transects is that too many are initially established and eventually resources may not be available to do an adequate job of remeasurement for monitoring purposes. Bear in mind the intensity needed and the reasons for monitoring when making decisions about number and placement of permanent transects. Also recognize that establishment of permanent transects does not automatically mandate frequent and regular remeasurements. Remeasurement intervals may be decades, or even unknown. Relocation of photo locations from the turn of the century is an example of a "remeasurement."

MARKING AND DOCUMENTING PERMANENT TRANSECTS

Locate permanent transects so they are effective in evaluating change over time. A key item to remember when installing a permanent transect is the ease of relocating the transect in the future. The following items should be addressed during installation:

- Locate transect locations on the allotment map and pin-prick aerial photos. Describe the transect location on the back of R2-2200-PH for all methods, including road or trail log, reference point description, distance and bearing to the plot from the road or trail, and plot center description.
- Use GPS (global positioning system) technology where possible to identify transect location.
- Mark the 0.0 foot and the 100.0 foot transect ends, or center point of the ocular plot, with a metal stake. The stake can be either 1-inch angle iron or 1/2-3/4 inch re-bar. Aluminum survey caps with imprinted transect numbers may be considered for marking the transects. Paint the stake yellow or orange to make it easier to find. It is also a good idea to paint a 6-8 inch rock and place it against the stake. This helps protect it from disturbance and also make the transect much easier to relocate.

PLANT IDENTIFICATION SKILLS

All methods require inventory crews to identify vegetative species encountered in the plots. Rangeland management specialists, wildlife biologists, foresters, soil scientists, ecologists, and other personnel involved in inventory of rangelands should be able to visually identify the common and significant species in the area. The inventory crew should also have available, and be able to use, reference material to properly identify all other vegetative species encountered.

Some of the more obscure plants may play a vital role in detecting trend. Identification of *all* vegetation encountered in the plots will prove critical to IRI, soil surveys, biodiversity assessments, Forest planning, and ecological classification efforts. Plant identification can be enhanced through self-study. All employees should be familiar with at least 25 of the local predominate graminoid species, 50 forb species, and 15 shrub species through plant collection or herbarium study.[10]

PHOTOGRAPHS

The following guidelines are universal for all sampling methods. Use them to ensure the highest quality photographs and documentation.

1. It is preferable to use a good quality 35mm camera with a 28mm wide angle lens. However, many modern compact automatic 35mm cameras will take good quality photographs suitable for monitoring purposes. Use color slide film (avoid Ektachrome film because colors tend to wash out due to ultraviolet light). Slide film is superior because good quality prints can be made from the slides, and the slides are still available for presentations.

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[10] References recommended for self-study are listed in Appendix D.

2. Record information on the Comments Form (R2-2200-CD) as necessary regarding lens size, photo direction (bearing), camera settings, and film speed. This is especially important for photographs that are highly probable of being included in a publication.
3. Pictures will be identified by placing symbols in chalk on a small blackboard, or by visibly displaying Form R2-2200-PH[11] with transect photo identification in the picture. For the 3 feet by 3 feet plot, the blackboard should be placed just behind the plot, and for the general view, alongside the tape.
4. Make notes on the R2-2200-CD Form that will help to identify the vegetation in the picture and other conditions worthy of note. Photo information is a permanent part of the transect record.

PHOTOGRAPHING OCULAR PLANT COMPOSITION SAMPLES

Photo records of ocular plots should capture the essence of the plot. Take as many photos as necessary to characterize the site.

1. Take a close-up photograph as described in Photographing Transects, number 2. This photograph should be taken standing at the plot center and facing up-slope. It is not necessary to set the camera at the specified 42 inches; the examiner can hold it at eye level. Use the 3 feet by 3 feet square formed by the carpenters rules, or some other indicator of scale in the photograph.
2. Four additional photos should be taken — one at each of the cardinal directions (Figure 3-6). These photos are to depict the landscape. Each photograph should be framed so that the area above the horizon fills one-fifth or less of the photo frame.

PHOTOGRAPHING TRANSECTS

Two photographs will be taken before reading the transect to show undisturbed vegetation. One photograph will be a close-up shot and the other a general view along the transect line (Figure 3-7). Photographs are inexpensive permanent records of any plot. Examiners should not hesitate to take as many pictures as are deemed necessary to capture important characteristics and features of the site.

1. Photographs will be taken from over the 0.0 foot stake, in the direction of the transect. The camera should be set up at an approximate height of 42 inches directly over the point, or high enough to include the entire 3 feet by 3 feet close-up plot, with Form R2-2200-PH or the identification board.

   The 3 feet by 3 feet plot will be established, using 6-feet folding carpenter rules (white) so the near edge is 3.5 feet from the stake and the far edge 6.5 feet from the stake. It is helpful to clip the rules together so that they will stay in place. Lay the carpenter rule frame on top of the transect tape.

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[11] See Appendix M

2. The general view will be taken down the transect line and should be focused at 20 feet. Pictures will appear neater if some sky is shown (20 percent or less of the picture). For best results, take pictures when the light is coming from the left or right of the camera (side lighting). Use a lens hood (sunshade) if available. Use as small an aperture and correspondingly slow shutter speed as possible, so depth of field is maximized.
3. Benchmark clusters will be numbered consecutively for each allotment. Transects will be numbered consecutively for each cluster. This numbering should be unchanged once it is established. The symbols should clearly show in the picture and not be obscured by vegetation.

Figure 3-6. OCULAR PLANT COMPOSITION PHOTOGRAPH LAYOUT

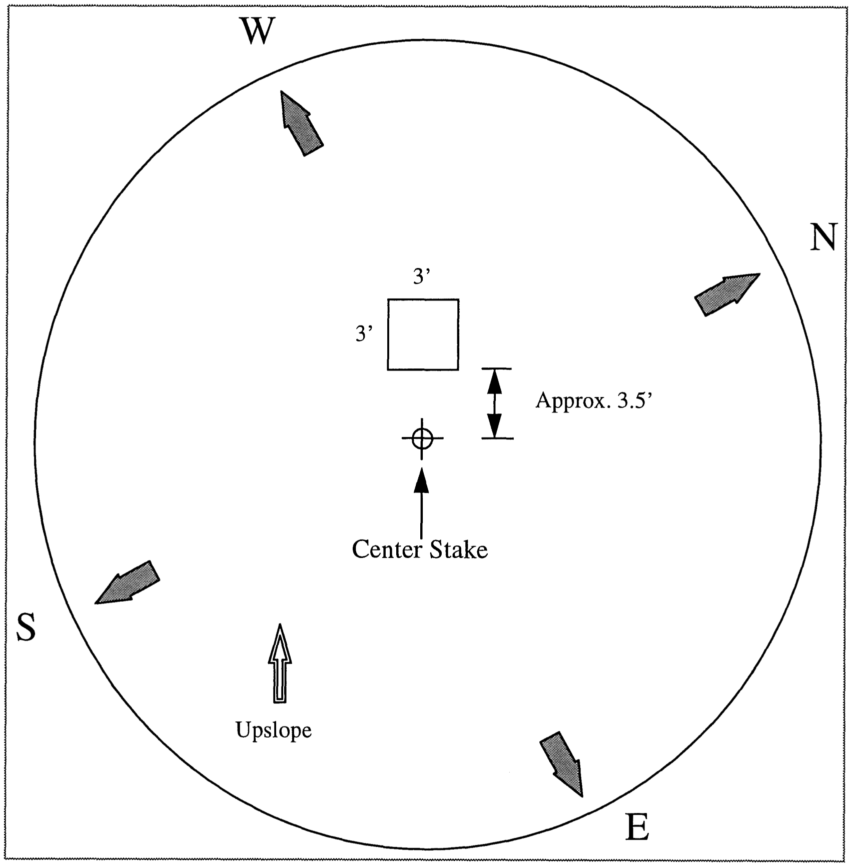
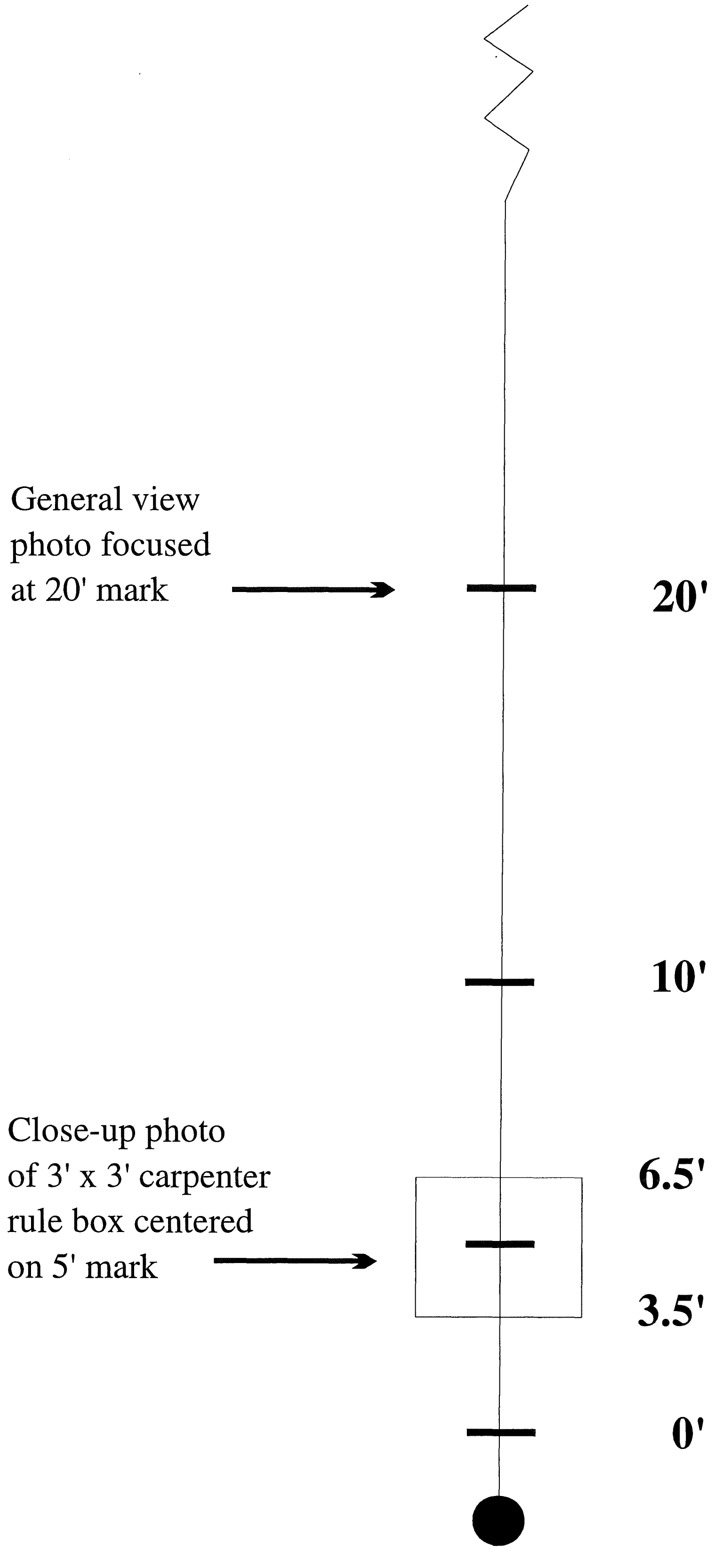


Figure 3-7. COVER-FREQUENCY PHOTOGRAPH LAYOUT



General view photo focused at 20' mark

Close-up photo of 3' x 3' carpenter rule box centered on 5' mark

EXHIBIT OP: OCULAR PLANT COMPOSITION

R2-2200-OP

GENERAL DISCUSSION

This sampling method is used to record ocular estimates of plant species canopy cover, height, shrub form class, phenology, and utilization. It is the primary method used for plant composition. Both full and reduced species lists are accommodated by this method. This method is simple to conduct in the field. It is relatively fast and therefore lends itself to many samples over large areas.

Calibration of ocular estimates should be conducted at the outset of inventory projects and occasionally (usually every 5 - 10 ocular plots) during the project. The examiner must calibrate ocular estimates by using cover-frequency and/or line intercept transect methods.

ADVANTAGES AND LIMITATIONS

The ocular plant composition method is adapted to areas where inventory data must be obtained over large areas using few examiners. It can be used to expand the sample size within a polygon or allotment as a supplement to cover-frequency transects. The ocular plant composition method is rapid and is a good method to use in communities with tall shrubs or trees.

TRAINING

Examiners must be knowledgeable in plant identification. It is relatively easy to learn to estimate canopy covers to the nearest percentage. Examiners usually calibrate their ocular estimates by periodically double sampling with cover-frequency transects. Variability between trained examiners on canopy cover estimates is usually minimal and is negated by the large number of samples that can be obtained with this method.

PERSONNEL AND EQUIPMENT

Equipment includes a 100-foot tape (marked in feet and tenths of feet), stakes for temporarily marking the ocular plot perimeter, flagging, and a camera. ***Two forms must be completed: General Field Data Form (R2-2200-GF) and Ocular Plant Composition Data Form (R2-2200-OP).***

SAMPLING PROCEDURE

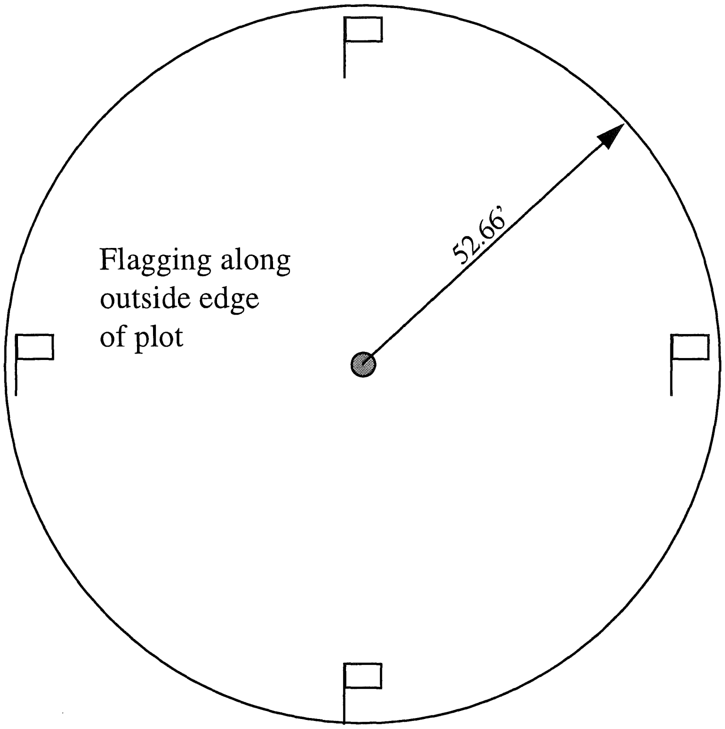
The plot is typically 0.10 acre in size and must be located within a representative, uniform portion of the vegetation and site characteristics being described. This means the plot should not cross ecotones of either vegetation or site characteristics, and should be representative of the general treatment or management practiced on the area to be described. However, in some cases the plot may be located to sample vegetation and site conditions within ecotones that are fairly broad.

The ocular plant composition plot is a circular plot with a radius of 37.25 feet and an area of 4,356 square feet (0.10 acre). Mark the center of the plot and then measure and flag the outside edge of the plot. Place flagging or metal pins upslope, downslope, and along the contour — left and right of plot center (Figure OP-1). Marking the perimeter of the sample can be omitted once the examiner is comfortable with the plot dimension(s).

Once the plot boundary is delineated, recon the plot and become familiar with plant species, ground cover, vegetation layers (if trees and shrubs are present), and other ecological characteristics.

After examination is complete, return to the center of the plot and visually estimate percent canopy cover by species, and percent ground cover. Record observations on the Ocular Plant Composition Form R2-2200-OP.

Figure OP-1. OCULAR PLANT COMPOSITION PLOT LAYOUT



FORM DESCRIPTION

R2-2200-OP

Order species by life form groups when completing this form. For example, enter all tree species at the top of the page followed by a blank line, and then enter all shrub species, skip a line and then enter all graminoid species, and so forth.

The field form allows for 85 plant species to be recorded but you may enter as many species as needed into the data base. If you have more than 85 species on the plot, continue the list on another field form. ***Ground cover values are recorded on R2-2200-GF.*** A field-by-field description follows.

SPATIAL IDENTIFIER (23-CHAR)

This field is the Spatial ID for the plot and links the data from the General Field Form with the Ocular Plant Composition data. Duplicate the spatial identifier here for the plot from the General Field Data (that is, field 1 of R2-2200-GF). See Exhibit GF for more details. This field cannot be left blank during data entry.

Required *Accuracy Standard = No Errors*

PURPOSE (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the next (Project) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional *Accuracy Standard = No Errors*

PROJECT (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the previous (Purpose) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional *Accuracy Standard = No Errors*

FLORA IDENTIFICATION SOURCE (4-CHAR)

This is a four-character code that identifies the source used to determine plant species identification. Synonyms are tracked through the NRCS PLANTS data base. Use the following codes.

Required ***Accuracy Standard = No Errors***

CODE	AUTHOR/DATE	FLORA
B49	Bailey, 1949	Manual of cultivated plants most commonly grown in the continental U.S. and Canada
B79	Bare, 1979	Wildflowers and weeds of Kansas
B68	Barkley, 1968	Manual of the Flowering Plants of Kansas
B69	Barrell, 1969	Flora of the Gunnison Basin
BJ85	Brunsfeld & Johnson, 1985	Field guide to the willows of east-central Idaho
C88	Carter, 1988	Trees and shrubs of Colorado
C74	Colson, 1974	Polyclave key to the Colorado and Wyoming species of Carex
CJ70	Correll & Johnston, 1970	Manual of the Vascular Plants of Texas
C+84	Cronquist, et al., 1984	Intermountain Flora: Vascular Plants of the Intermountain West, USA
D77	Dorn, 1977	Manual of the plants of Wyoming
D88	Dorn, 1988	Vascular plants of Wyoming
DD77	Dorn & Dorn, 1977	Flora of the Black Hills
E76	Elmore, 1976	Shrubs and trees of the Southwest Uplands
F93	1993	Flora of North America, North of Mexico
GN86	Goodrich & Neese, 1986	Uinta Basin Flora
H+87	Hallsten, et al., 1987	Grasses of Wyoming
H54	Harrington, 1954	Manual of the plants of Colorado
H70	Hermann, 1970	Manual of the Carices of the Rocky Mountains and Colorado Basin
H76	Hermann, 1976	Manual of the rushes (Juncus spp.) of the Rocky Mountains and Colorado Basin
HC50	Hitchcock & Chase, 1950	Manual of the Grasses of the United States
HC69	Hitchcock & Cronquist, 1969	Key to [grass] species based upon vegetative characters
HC73	Hitchcock & Cronquist, 1973	Flora of the Pacific Northwest
J64	Johnson, 1964	Field key to the Sedges of Wyoming
K87	Kindscher, 1987	Edible wild plants of the prairie: An ethnobotanical guide
K70	Kirk, 1970	Wild edible plants of western North America
LM85	Lampe & McCann, 1985	AMA handbook of poisonous and injurious plants
MB77	McGregor, et al., 1977	Atlas of the Flora of the Great Plains
M+86	McGregor, et al., 1986	Flora of the Great Plains
M56	McKean, 1956	Winter guide to native shrubs of the central Rocky Mountains
N74	Nelson, 1974	Vascular plants of the Medicine Bow Mountains, Wyoming
N79	Nelson, 1979	Handbook of Rocky Mountain Plants
P75	Pesman, 1975	Meet the natives
S69	Stephens, 1969	Trees, Shrubs, and Woody Vines in Kansas
S73	Stephens, 1973	Woody Plants of the North Central Plains
V86	Van Bruggen, 1986	The Vascular Plants of South Dakota
V69	Von Frieden, 1969	Mushrooms of the world
W76	Weber, 1976	Rocky Mountain Flora
W86	Weber, 1986	Colorado Flora: Western Slope
W90	Weber, 1990	Colorado Flora: Eastern Slope
W+87	Welsh, et al., 1987	A Utah Flora
YY86	Young & Young, 1968	Geology and wildflowers of Grand Mesa, Colorado

FLORA IDENTIFICATION LEVEL (2-NUM)

Enter the minimum percent canopy cover for species identified. For example, "05" indicates that all plants with 5 percent or more canopy cover are identified to species, "00" indicates that *all* plant species are identified. It is recommended that 1 or 5 percent cover be used as the minimum identification level *when* sampling objectives require a reduced species list. Collect full species lists wherever feasible.

Note species on the field form which because their presence alone is significant, and have cover values less than the plant identification level (for example, noxious weeds, habitat type indicator species, or threatened, endangered, or sensitive species).

Required *Accuracy Standard = No Errors*

SAMPLE UNIT SIZE

Enter dimension(s) of plot on which ocular plant composition data was collected. Distinguish between plot size for live and dead material.

RADIUS (5-NUM)

Enter plot radius, if circular, to nearest tenth of unit.

Required *Accuracy Standard = No Errors*

LENGTH (5-NUM)

Enter plot length, if rectangular, to nearest tenth of unit

Required *Accuracy Standard = No Errors*

WIDTH (5-NUM)

Enter plot width, if rectangular, to nearest tenth of unit

Required *Accuracy Standard = No Errors*

UNIT OF MEASURE (2-CHAR)

Enter unit of measure for sample unit dimensions. For example, FT = feet and M = meters.

Required *Accuracy Standard = No Errors*

HEIGHT UNIT OF MEASURE (2-CHAR)

Enter unit of measure for height values. For example, FT = feet and M = meters.

Required *Accuracy Standard = No Errors.*

DIAMETER UNIT OF MEASURE (2-CHAR)

Enter unit of measure for diameter values. For example, IN = inch and CM = centimeter.

Required *Accuracy Standard = No Errors.*

LENGTH UNIT OF MEASURE (2-CHAR)

Enter unit of measure for length values. For example, FT = feet and M = meters.

Required *Accuracy Standard = No Errors.*

LIFE FORM (2-CHAR)

Use the following codes to describe the life form of each species.

Required *Accuracy Standard = No Errors.*
Source = CSDS: Life forms.

CODE	LIFE FORM
T	tree
TR	woody tree
S	shrub
SH	woody shrub
SS	woody sub-shrub
ST	succulent
LI	woody liana
G	grass
GR	herbaceous graminoid
F	forb
FB	herbaceous forb/herb
VI	herbaceous vine
P	pteridophyte (fern and fern allies)
AL	algae
B	bryophyte (mosses and liverworts)
CL	crustose lichen
FO	foliose lichen
FR	fruiticose lichen
FU	fungus

NOTE: Whenever a plant species symbol is required, use the 8-character alpha-numeric codes from the Natural Resource Conservation Service's PLANTS data base. Lists of all species by state are available.

SPECIES (8-CHAR)

For vascular plant species, use the 8-character alpha-numeric code from the NRCS PLANTS data base. Identify plants to species, if possible. For genus identification, enter the appropriate genus code (for example, "AGROP2" for *Agropyron* spp.).

Ground cover estimates are no longer on this form as they are a duplicate of the ground cover section on the General Field Data form. Complete that form for each plot, or cluster of plots. The purpose of collecting ground cover data is to describe the ground surface. Interpretations regarding soil surface protection, erosion probability, organic matter contribution, and effects of use such as recreation, grazing, and mechanical activity will be made from this data.

Therefore, the question of whether moss covering a rock should be recorded as "moss" or "rock" is evaluated against the data objective. The result is to record cover as stone, boulder, etc. — whichever describes the soil surface and is what affects the above interpretations. In addition, moss that is growing directly on the soil surface should be recorded as "moss".

As a vegetative entity, the cover of moss should be captured by recording a bryophyte ("B") life form, "MOSS" species, and the appropriate percent cover. Do not record any moss cover more than once.

Required
Accuracy Standard = No error in species level identification for dominant, common, or community type indicator plants. 95 percent or more of species with canopy cover greater than or equal to the plant identification level specified must be accurately identified, or at minimum, identified to genus or life form. Examiner should request verification of questionable plant identification from a person locally recognized for their ability to identify plants. No plant name should be repeated within a layer.
Source = NRCS PLANTS database

LAYER HEIGHTS

Layer data provides structural information about the stand. To specify layers, group individuals by species into one of more layers. There can be multiple layers for each species as long as the breaks are logical and consistent. If clear breaks cannot be determined, do not split them.

Use the following guidelines to determine naturally occurring layers in the stand. These guidelines are most applicable to forested stands, but have applicability to shrublands as well. Forested stands are commonly observed and described by the following layers: seedling, sapling, pole, suppressed, intermediate, codominant, and dominant. These same definitions can be used to mentally subdivide the stand. Not all layers will be present. And on occasion, there may actually be two or more layers within the traditional forestry concepts. *The objective is to adequately describe the stand structure, without getting inordinately detailed.*

For example, one ponderosa pine layer might be individuals over 50 feet tall; another layer would be individuals between 25 and 50 feet; a third layer would be 5 to 25 feet; and a fourth layer would be seedlings and saplings less than 5 feet.

Several layers may be described for each species. Record the minimum, average, and maximum height for each observable layer within the recorded species. A layer description is optional for graminoid and forb life forms.

MINIMUM HEIGHT (4-NUM)

Enter the average minimum height of the layer to the nearest tenth of a foot. This value represents the average height of the shortest individuals occupying the layer.

Required
Accuracy Standard = ± 10 percent of height

AVERAGE HEIGHT (4-NUM)

Enter the average height of the layer to the nearest tenth of a foot. This value is the average height of all individuals in the layer.

Required
Accuracy Standard = ± 10 percent of height

MAXIMUM HEIGHT (4-NUM)

Enter the average maximum height of the layer to the nearest tenth of a foot. This value is the average height of the tallest individuals occupying the layer.

Required
Accuracy Standard = ± 10 percent of height

AVERAGE DIAMETER (3-NUM)

Record the average diameter to the nearest 1 inch class. If there are three ponderosa pine trees within a layer with diameters of 12 inches, 16 inches, and 17 inches, the average diameter recorded is 15 inches. If there are two distinctive sizes within a layer, the species can be entered twice. Use "00" for established tree seedlings. Diameter is taken at breast height for all trees, except junipers and piñon pine where diameter is taken at the root collar. Diameter is also recorded for standing dead or down dead trees or shrubs.

Required
Accuracy Standard = ± 10 percent of diameter

DIAMETER LOCATION

Record the location where the diameter was estimated.

BH = breast height (4.5 ft)
RC = root collar
MP = mid point (for down and dead)

Required ***Accuracy Standard = No error***
Source = IRI-CVU (U.S. Forest Service, 1995)

CANOPY COVER (3-NUM)

Enter the best estimate of canopy cover for each species by layer. This percentage is unique to that particular layer/species combination. Canopy cover estimates are used to quantify vegetative biomass on the site. The combination of canopy cover with layer descriptions provides a means for making interpretations regarding stand development, seral condition, wildlife cover, and other vegetation dependent characteristics.

Percent cover for a species can total more than 100 percent. For example, two layers of lodgepole pine would be considered independently. Leave percent cover blank for standing dead trees and for down material.

The actual cover observed during field sampling is recorded in this field. If a particular species was sampled sufficiently early or late in the year that its cover at peak phenological development would be greater or lower than observed, make a comment in the Notes field.

Required
Accuracy Standard = ± 10 percent of mean

MATURITY (1-CHAR)

Record the appropriate maturity code for the life form. Codes are available for shrub and tree species. The following codes are used to indicate relative maturity or physiological age rather than actual age. This is a substitute for boring trees to determine age. Differences in site, elevation, moisture and other environmental factors influence the age at which trees reach maturity. Trees generally reach maturity earlier on poor sites than on good sites.

Trees and shrubs are divided into the following maturity classes that were developed for ponderosa pine only. Maturity estimates for other species will have to be estimated by the age of core sampled trees.

Required ***Accuracy Standard = Good Judgment***

AGE (3-NUM)

Record the age of core sampled trees or shrubs in the layer the tree or shrub falls within. For example, 50 years is the recorded age for a layer with three ponderosa pines of 45, 50, and 55 years old. Age is most often needed for tree species, but may occasionally by taken for shrub species. No add-on factor is applied to the age. Use the core samples to calibrate maturity class estimates, being conservative in the number of trees sampled.

Required
Accuracy Standard = ± 10 percent of age

TREE MATURITY CLASSES

CODE	DESCRIPTION	CROWNS	BRANCHES	BARK
Y	Young: trees appear young	pointed	distinct whorls, upturned, small in comparison with the main stem	generally smooth and not platey
I	Immature: trees appear middle-aged	may be pointed or slightly rounded, but never flat	slightly flattened lower branches	slightly rough, plates beginning to form
M	Mature: trees slightly showing age	pyramidal or rounded, occasionally pointed	flattened lower branches	rough, somewhat platey
O	Overmature: trees show age	flattened or rounded, but never pointed	open, large, gnarled or misshapen upper branches	platey or deeply furrowed
D	Dead: standing dead	N/A	N/A	N/A

SHRUB MATURITY CLASSES

CODE	DESCRIPTION	CROWNS	BRANCHES	BARK
Y	Young: relatively young plant	not rounded and are made up of all living wood; larger than a sprout or seedling (1/8-inch to 1/2-inch diameter at the base, varying with species)	more complex branching; may possess multiple basal stems but is attached to a relatively small root stock (except for saplings); may or may not show signs of flowering and seed production	more fibrous but is not fissured as with a mature plant
M	Mature: shrubs slightly showing age	rounded growth form, large, heavy, often gnarled stems and a firmly established predominant root stock; root crown is made up of three-quarters or more living wood	complex branching and multiple stems; evidence of flowering and or seed production is present	fibrous fissured bark
O	Overmature	mature plant which possesses more than 50 percent dead wood in the crown	N/A	N/A
X	Dead: standing dead	obviously does not possess any live crown, but the root is still firmly attached (downed, unattached, woody stems are considered litter)	N/A	N/A

VIGOR (1-CHAR)

For life forms describe the overall health, vigor, and maturity of crowns within a canopy layer. Record the appropriate vigor code for live trees. These class descriptions can be applied to all tree layers.

Required *Accuracy Standard = Good Judgment*

NUMBER OF DEAD (3-NUM)

Record the number of dead standing trees greater than 5 inches in diameter at breast height. On a separate line record the dead down material greater than 5 inches in diameter. Both are based on the sample size specified for dead material. At least half of the down piece must lie within the plot in order to be counted.

Required *Accuracy Standard = ± 10 percent*

DECAY (1-CHAR)

For dead standing trees or down material, record the condition of the standing dead tree or down piece using one of the five decay classes depicted (Figure OP-2). Detailed descriptions of down material decomposition classes are provided. These descriptions, along with a relative value (last row of table), are useful in determining the snag condition class as well.

Required *Accuracy Standard = Good Judgment.*
Source = Thomas (1979)

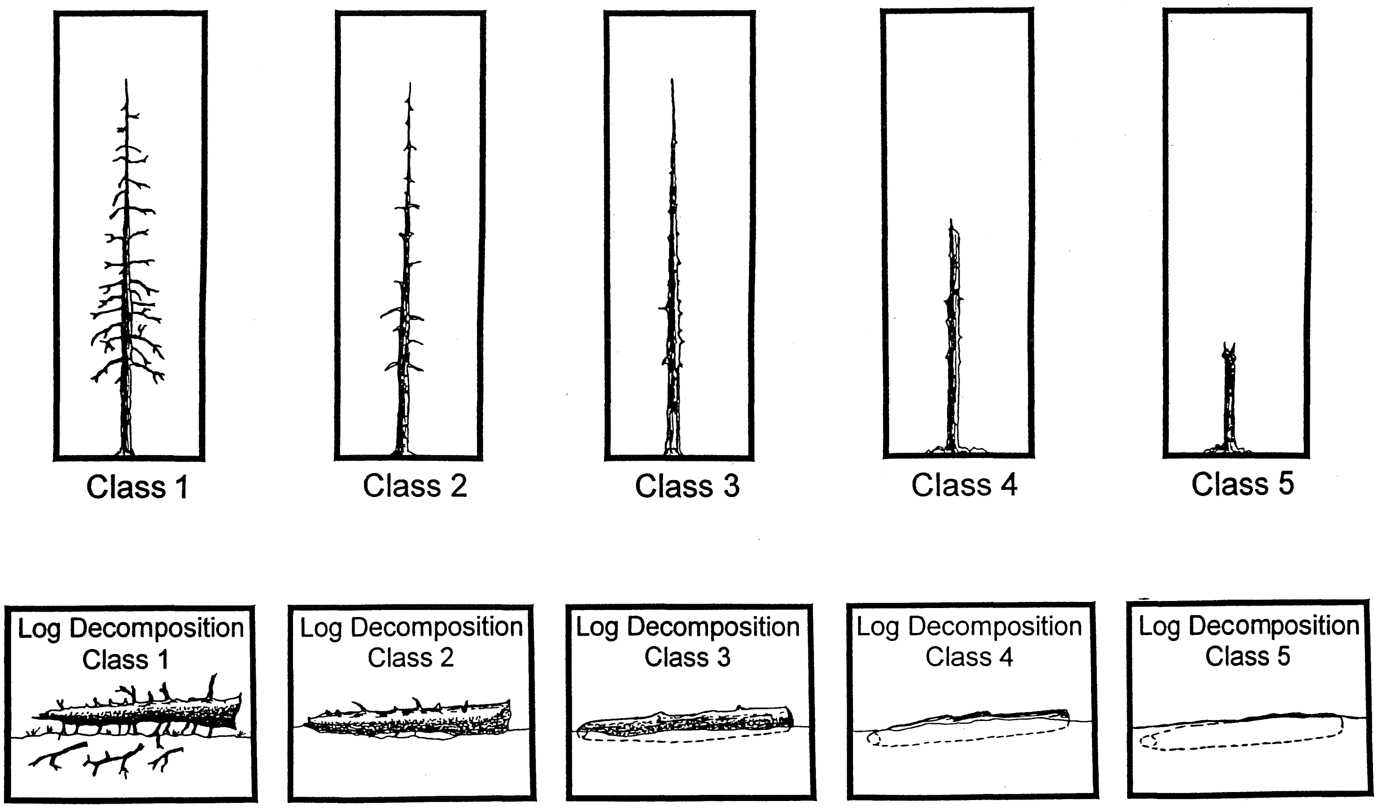
VIGOR CLASSES

CODE	DESCR	CROWNS	FOLIAGE	POSITION	DBH
F	Full	well filled out vigorous crown	usually very dense and thrifty; individual leaves being of average length or longer	usually isolated or dominant	large for age
M	Medium	fair to moderately vigorous crown or a longer crown if narrow or somewhat thin; either short wide crowns or long narrow ones, but neither sparse nor ragged	usually thrifty; of full to medium density and of average length	usually co-dominant but often isolated or dominant	above average for age
L	Light	fair to poor vigor; either short or long, sparse and narrow	usually short and from medium to poor density; of normal length and density when confined to the top third of the tree	usually intermediate or sometimes co-dominant, but rarely isolated	usually below average
W	Weak	usually of very poor vigor, often quite thin and sickly, consisting of a tuft at the top of the tree or dead top	usually short and of poor to very poor density, very sparse and scattered or only partially developed; often barely sufficient to maintain life	usually suppressed or intermediate or if dominant or co-dominant it is suffering from some vigor reducing ailment such as severe insect attack, lightning strike or very old age	usually decidedly subnormal, but very old; damaged trees are often of large diameter

FIVE-CLASS SYSTEM OF LOG DECOMPOSITION

Log Characteristics	Log Decomposition Class				
	1	2	3	4	5
Bark	intact	intact	trace	absent	absent
Twigs <3 cm (1.2 in)	present	absent	absent	absent	absent
Texture	intact	intact to partly soft	hard, large pieces	small, soft, blocky pieces	soft and powdery
Shape	round	round	round	round to oval	oval
Wood Color	original color	original color	original color to faded	light brown to faded brown or yellowish	faded to light yellow or gray
Portion of log on ground	log elevated on support points	log elevated on support points but sagging slightly	log is sagging near ground	all of log on ground	all of log on ground
Snag Condition relative to Log Decomposition Class	hard snag	hard snag	soft snag	soft snag, >70% soft sapwood	disintegrated

Figure OP-2. STANDING DEAD AND DOWN MATERIAL DECAY CLASSES


Class 1
Class 2
Class 3
Class 4
Class 5
Log Decomposition Class 1
Log Decomposition Class 2
Log Decomposition Class 3
Log Decomposition Class 4
Log Decomposition Class 5

DOWN LENGTH (3-NUM)

Record the average length for down material. Round to the nearest one unit.

Required
Accuracy Standard = ± 10 percent of length

NOTES

Available for any short comments. During the transition period between using other species coding systems and the NRCS PLANTS data base codes, it is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the code species symbol can be confused for more than one species.

Optional ***Accuracy Standard = Good Judgment***

NOTE: Any comments concerning your plot should be recorded on the Comments Data Form (R2-2200-CD). Use Form CD if you want an electronic record of your comments.

The following table displays data elements generally completed by life form.

DATA ELEMENTS BY LIFE FORM

	Life		Layer Heights			Avg	Diam	Canopy	Live			Dead		
	Form	Species	Min	Avg	Max	Diam	Loc	Cover	Mat	Age	Vigor	#	Decay	Length
Tree	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Shrub	X	X	X	X	X			X						
Graminoid	X	X						X						
Forb	X	X						X						

OCULAR PLANT COMPOSITION
(R2-2200-OP)

SPATIAL ID FS 02 12 10 373010830 0045 94

PURPOSE/PROJECT TABLE MESA / RED BLUFF

FLORA IDENTIFICATION SOURCE: W86

FLORA IDENTIFICATION LEVEL: 00

Sample Unit Size	Live	Dead	U of M
Radius	52.7	74.5	FT
Length			
Width			

HEIGHT UNIT OF MEASURE FT DIAMETER UNIT OF MEASURE IN LENGTH UNIT OF MEASURE FT

	LF	Species	Layer Heights			Avg	Diam	Canopy	Live (only)			Dead (only)			Notes
			Min	Avg	Max	Diam	Loc	Cover	Mat	Age	Vigor	#	Decay	Len	
1	**T**	**POTR5**	**10**	**18**	**20**	**4**	**BH**	**10**	**Y**	**30**	**M**				*P. tremuloides*
2	**T**	**POTR5**	**1**	**4**	**8**	**1**	**BH**	**5**	**Y**	**10**	**M**				
3	**T**	**POTR5**	**3**	**8**	**15**	**2**	**BH**					**8**	**2**		
4	**T**	**SABE2**	**1**	**2**	**2**	**1**	**BH**	**3**	**Y**						*S. bebbiana*
5	**S**	**ARTRV**	**1**	**2**	**2**			**20**							
6	**S**	**SYOR2**	**0**	**1**	**1**			**2**							
7	**S**	**CHNA2**	**0**	**1**	**1**			**1**							
8	**S**	**CHVI8**	**1**	**1**	**3**			**2**							
9	**S**	**RILA**	**0**	**1**	**2**			**1**							
10	**S**	**SARA2**	**1**	**1**	**2**			**3**							
11	**G**	**FETH**						**2**							
12	**G**	**CAEL3**						**2**							
13	**G**	**POPR**						**10**							
14	**G**	**PONE2**						**50**							
15	**G**	**CAGE2**						**1**							
16	**G**	**KOMA**						**2**							
17	**G**	**CAFI**						**2**							
18	**G**	**KOCR**						**1**							
19	**G**	**PASM**						**5**							
20	**G**	**BROMU**						**5**							
21	**F**	**ACLA5**						**25**							
22	**F**	**TAOF**						**20**							
23	**F**	**MEFU2**						**5**							
24	**F**	**LATHY**						**10**							
25	**F**	**VIAM**						**10**							
26	**F**	**DEBA2**						**5**							
27	**F**	**RAGL**						**4**							
28	**F**	**NOMO2**						**1**							*Noccaea montana*
29	**F**	**ANSE4**						**1**							
30															
31															
32															
33															
34															
35															
36															
37															
38															
39															
40															

OCULAR PLANT COMPOSITION
(R2-2200-OP)

SPATIAL ID FS 02 12 10 373010830 0045 94

	LF	Species	Layer Heights			Avg Diam	Diam Loc	Canopy Cover	Live (only)			Dead (only)			Notes
			Min	Avg	Max				Mat	Age	Vigor	#	Decay	Len	
41															
42															
43															
44															
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85															

EXHIBIT CF: COVER-FREQUENCY TRANSECT

R2-2200-CF

GENERAL DISCUSSION

In many cases, this is the most commonly used vegetative inventory method. The cover-frequency transect is commonly used to provide quantitative measurements of canopy cover and frequency by plant species, ground cover, and production by life form for inventory and monitoring purposes. It is used when a replicated sampling design and statistical analysis is required. It is also used to calibrate ocular estimates of canopy cover when crews are unfamiliar with the ocular plant composition method. Use this method for low shrubs (less than 2.5-3.5 feet tall) and herbaceous species.

ADVANTAGES AND LIMITATIONS

This method is relatively fast and easy to learn. It is applicable to a wide variety of plant species. Canopy cover and frequency is widely used in vegetation classifications throughout the western United States. A limitation of this method is with vegetation over 3.5 feet tall, in which case the examiner may want to use the line intercept method as a supplement.

TRAINING

Examiners must be knowledgeable in plant identification. Estimating canopy cover by species using a plot frame and cover classes is relatively easy to learn.

PERSONNEL AND EQUIPMENT

Required equipment for completing a cover-frequency transect includes a 20 x 50 cm plot frame (Figure CF-1), as described by Daubenmire (1959), painted to indicate the seven standard cover classes;[1] a 100-foot tape marked in feet and tenths of feet; temporary stakes for transect ends (large screwdrivers with orange or yellow handles work well); and permanent stakes if the transect is to be permanently established. ***Two forms must be completed: General Field Data (R2-2200-GF) and Cover-Frequency Data (R2-2200-CF).***

The frame is made of 0.5 inch PVC or 0.25 inch metal rod. *Note: Do not use material larger than 0.5 inch outside diameter. The larger diameter material reduces accuracy.* Inside dimensions of the frame are 20 x 50 cm. The frame is open-ended to facilitate placement under dense or tall vegetation.

The 'Daubenmire' cover class frame is divided into fourths by painting alternate sections of the frame different colors as illustrated. Use orange and white or red and white paint schemes.

In one corner of the frame, delineate two sides of an area 7.1 cm square (inside dimension) as illustrated. This area represents 5 percent of the plot area. In the opposite corner, delineate two sides of an area 3.2 cm square (inside dimension). This area represents 1 percent of the plot area. The painted design provides visual reference areas equal to 1, 5, 25, 50, 75, 95, and 100 percent of the plot area.

An alternative painting scheme and set of cover classes can be used as shown in Figure CF-1. The painted design on this frame provides visual reference areas equal to 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 99, and 100 percent at the plot area.

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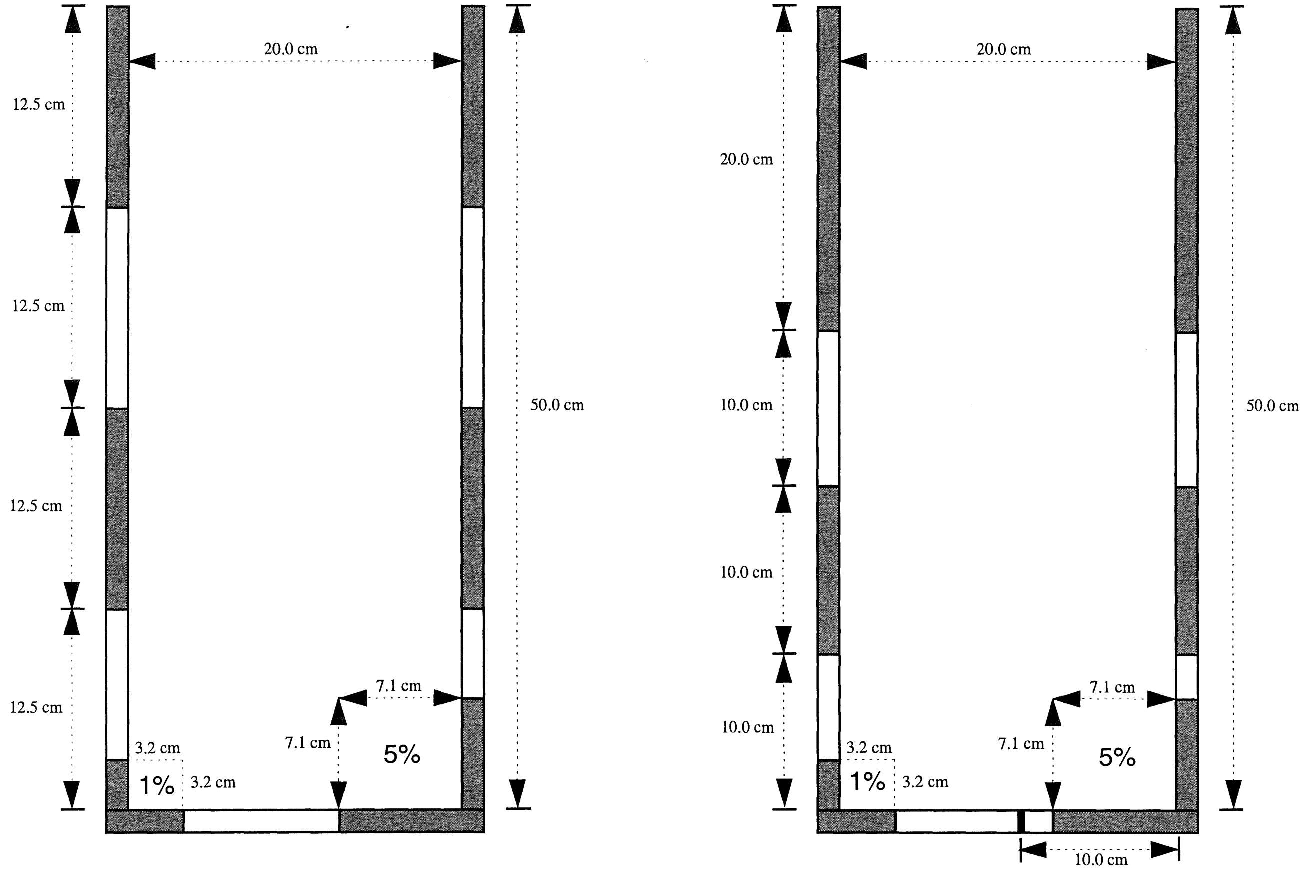
[1] The trace (0-1%) class has been added to Daubenmire's original classes.

Figure CF-1. COVER-FREQUENCY FRAMES (20x50 cm)


20.0 cm
12.5 cm
12.5 cm
12.5 cm
12.5 cm
50.0 cm
7.1 cm
7.1 cm
5%
3.2 cm
3.2 cm
1%
20.0 cm
20.0 cm
10.0 cm
10.0 cm
10.0 cm
50.0 cm
7.1 cm
7.1 cm
5%
3.2 cm
3.2 cm
1%
10.0 cm

'Daubenmire' classes

'10-classes'

Canopy Cover Classes ('Daubenmire')

CODE	RANGE	MIDPOINT
T	0 - 1.0%	0.5%
1	1.1 - 5.0%	3.0%
2	5.1 - 25.0%	15.0%
3	25.1 - 50.0%	37.5%
4	50.1 - 75.0%	62.5%
5	75.1 - 95.0%	85.0%
6	95.1 - 100.0%	97.5%

Canopy Cover Classes('10-Classes')

CODE	RANGE	MIDPOINT
T	0 - 1.0%	0.5%
0	1.1 - 5.0%	3.0%
1	5.1 - 15.0%	10.0%
2	15.1 - 25.0%	20.0%
3	25.1 - 35.0%	30.0%
4	35.1 - 45.0%	40.0%
5	45.1 - 55.0%	50.0%
6	55.1 - 65.0%	60.0%
7	65.1 - 75.0%	70.0%
8	75.1 - 85.0%	80.0%
9	85.1 - 95.0%	90.0%
A	95.1 - 99.0%	97.0%
X	99.1-100.0%	99.5%

SAMPLING PROCEDURE

Canopy cover is two-dimensional evaluation of the influence each plant species exerts over other components of the ecosystem, that is, the dominance of the species.

TRANSECT LAYOUT

1. Recon the entire site, making mental notes. Choose homogeneous portions of the site for transect locations, away from ecotones and unusual (very minor acreage) micro-sites. Choose transect orientation that will correctly reflect relative acreage of microsites or patches that are uniformly distributed (pattern) throughout the site. Transect location and orientation are designed to accurately describe the site (not the type, nor the micro-site) for both vegetation and soil.
2. Put in a pin at transect start (screwdriver, re-bar, or pipe), draw tape tight, and put in pin at other end to hold tape while reading.
3. Place range pole or upright plot frame for scale, and identification sheet (R2-2200-PH) at transect start. Take photos before reading the transect (page 3-34).
4. Twenty plot frames will be placed on right side of tape at 5 foot intervals beginning at the 0 foot point on the tape. The lower left corner of the plot frame will be placed adjacent to the appropriate foot mark on the tape. Refer to plot frame placement diagram (Figure CF-2).
5. At each plot frame, estimate ground cover and live foliar canopy cover by species and record using seven standard cover classes or ten (thirteen) standard cover classes (Figure CF-1). Also estimate ground cover categories: bare soil and other mineral particle classes, litter and wood, moss and lichen, basal vegetation, and water. Canopy cover values will not necessarily sum to 100 percent, while ground cover estimates will sum to 100 percent.
6. Repeat steps 2-4 for a second parallel transect at least 50 feet apart.

RECORDING DATA

Consider all (live) individuals of one species in the plot frame as a unit, ignoring for the moment all other kinds of plants. Also ignore dead individuals or dead branches of live individuals; record dead individuals and branches on a separate line if needed.

Imagine a line drawn about the leaf tips of the undisturbed canopies (ignoring inflorescence) and project those polygonal images onto the ground. This projection is considered "canopy cover" for the species being considered.

Decide which of the classes (Figure CF-1) the canopy coverage of the species falls into, and record this value. Then consider the remaining species in turn (Figure CF-3).

Note that a plant does not have to be rooted in the plot frame to have coverage over it. Small openings within the canopy are included in the measurement. This is not an estimate of leaf area.

Figure CF-2. COVER-FREQUENCY TRANSECT LAYOUT

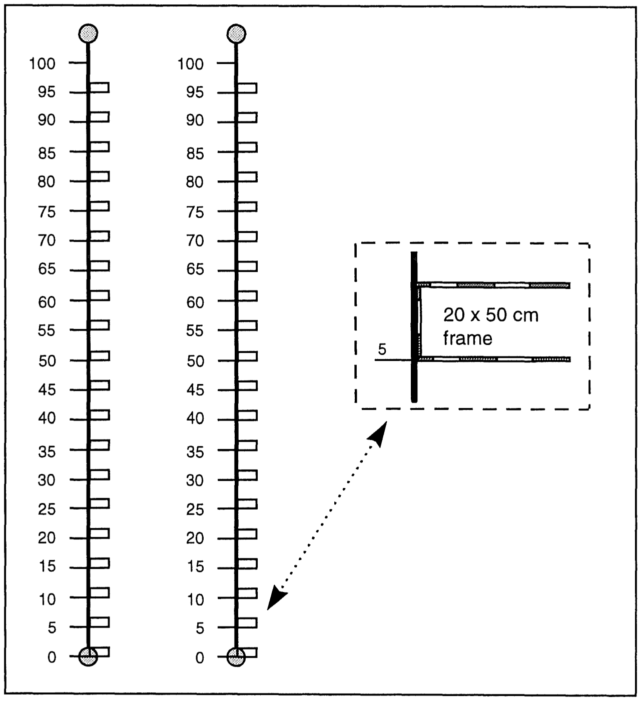
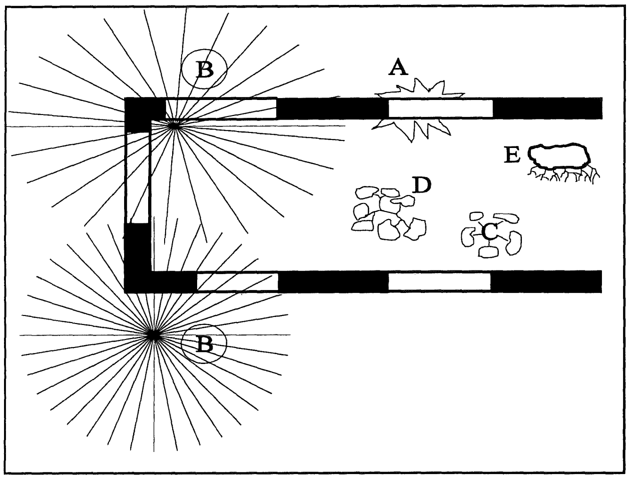


Figure CF-3. LIVE FOLIAR COVER DIAGRAM



Examples of estimating canopy cover classes (From Daubenmire, 1959):

Species A:	Cover class "T" (0-1% cover)
Note:	***Estimate cover inside the frame even though base of plant may be outside frame.***
Species B:	Cover class "3" (25-50% cover)
Species C:	Cover class "1" (1-5% cover)
Species D:	Cover class "2" (5-25% cover)
Species E:	Cover class "1" (1-5% cover)
Note:	***Do not count dead cover.***

FORM DESCRIPTION
R2-2200-CF and R2-2200-CFSum

The Cover-Frequency Data Form (R2-2200-CF) accommodates up to 75 items and 20 plot frames per transect. If there are more than 75 species on the transect, use additional field sheets as appropriate (that is, the data base can accommodate as many species as are present on up to 10 transects).

A summary data form (R2-2200-CFSum) is provided which is used in data entry (that is, information by species is entered by transect summary not by individual plot frame).

SPATIAL IDENTIFIER (23-CHAR)

Enter the Spatial ID identified in Field 1 of the General Field Data Form (R2-2200-GF).

Required *Accuracy Standard = No Errors*

PURPOSE (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the next (Project) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional *Accuracy Standard = No Errors*

PROJECT (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the previous (Purpose) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional *Accuracy Standard = No Errors*

FLORA IDENTIFICATION SOURCE (4-CHAR)

This is a four-character code identifying the source used for plant species identification. Synonyms are tracked through the NRCS PLANTS data base. Use the following codes.

Required ***Accuracy Standard = No Errors***

CODE	AUTHOR/DATE	FLORA
B49	Bailey, 1949	Manual of cultivated plants most commonly grown in the continental U.S. and Canada
B79	Bare, 1979	Wildflowers and weeds of Kansas
B68	Barkley, 1968	Manual of the Flowering Plants of Kansas
B69	Barrell, 1969	Flora of the Gunnison Basin
BJ85	Brunsfeld & Johnson, 1985	Field guide to the willows of east-central Idaho
C88	Carter, 1988	Trees and shrubs of Colorado
C74	Colson, 1974	Polyclave key to the Colorado and Wyoming species of Carex
CJ70	Correll & Johnston, 1970	Manual of the Vascular Plants of Texas
C+84	Cronquist, et al., 1984	Intermountain Flora: Vascular Plants of the Intermountain West, USA
D77	Dorn, 1977	Manual of the plants of Wyoming
D88	Dorn, 1988	Vascular plants of Wyoming
DD77	Dorn & Dorn, 1977	Flora of the Black Hills
E76	Elmore, 1976	Shrubs and trees of the Southwest Uplands
F93	1993	Flora of North America, North of Mexico
GN86	Goodrich & Neese, 1986	Uinta Basin Flora
H+87	Hallsten, et al., 1987	Grasses of Wyoming
H54	Harrington, 1954	Manual of the plants of Colorado
H70	Hermann, 1970	Manual of the Carices of the Rocky Mountains and Colorado Basin
H76	Hermann, 1976	Manual of the rushes (Juncus spp.) of the Rocky Mountains and Colorado Basin
HC50	Hitchcock & Chase, 1950	Manual of the Grasses of the United States
HC69	Hitchcock & Cronquist, 1969	Key to [grass] species based upon vegetative characters
HC73	Hitchcock & Cronquist, 1973	Flora of the Pacific Northwest
J64	Johnson, 1964	Field key to the Sedges of Wyoming
K87	Kindscher, 1987	Edible wild plants of the prairie: An ethnobotanical guide
K70	Kirk, 1970	Wild edible plants of western North America
LM85	Lampe & McCann, 1985	AMA handbook of poisonous and injurious plants
MB77	McGregor, et al., 1977	Atlas of the Flora of the Great Plains
M+86	McGregor, et al., 1986	Flora of the Great Plains
M56	McKean, 1956	Winter guide to native shrubs of the central Rocky Mountains
N74	Nelson, 1974	Vascular plants of the Medicine Bow Mountains, Wyoming
N79	Nelson, 1979	Handbook of Rocky Mountain Plants
P75	Pesman, 1975	Meet the natives
S69	Stephens, 1969	Trees, Shrubs, and Woody Vines in Kansas
S73	Stephens, 1973	Woody Plants of the North Central Plains
V86	Van Bruggen, 1986	The Vascular Plants of South Dakota
V69	Von Frieden, 1969	Mushrooms of the world
W76	Weber, 1976	Rocky Mountain Flora
W86	Weber, 1986	Colorado Flora: Western Slope
W90	Weber, 1990	Colorado Flora: Eastern Slope
W+87	Welsh, et al., 1987	A Utah Flora
YY86	Young & Young, 1968	Geology and wildflowers of Grand Mesa, Colorado

FLORA IDENTIFICATION LEVEL (2-NUM)

Enter the minimum percent canopy cover for species identified. For example, "05" indicates that all plants with 5 percent canopy cover or greater are identified to species, "00" indicates that *all* plant species have been identified (that is, a full species list was collected). It is recommended 1 or 5 percent cover be used as the minimum identification level *when* sampling objectives require a reduced species list. Collect full species lists wherever feasible.

Note species on the field form which because their presence alone is significant, and have cover values less than the plant identification level (for example, noxious weeds, habitat type indicator species, or threatened, endangered, or sensitive species).

Required *Accuracy Standard = No Errors*

NUMBER OF TRANSECTS (2-NUM, 2-NUM)

Identify which transect this form is for by identifying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually two. This number cannot exceed ten.

Required *Accuracy Standard = No Errors*

TRANSECT LENGTH (3-NUM, 2-CHAR)

Enter the total length of the transect and the unit of measure. For example, FT = feet and M = meters. The standard length for the Rocky Mountain Region is 100 feet.

Required *Accuracy Standard = No Errors*

NUMBER OF FRAMES PER TRANSECT (2-NUM)

Enter the number of plot frames used to record cover and/or frequency along a transect. The standard, and minimum, number of plot frames for the Rocky Mountain Region is 20. More than 20 may be used if the variability of the site or other reasons warrant. Do not use less than 20 plot frames per transect.

Required *Accuracy Standard = No Errors*

FRAME RADIUS OR LENGTH, AND WIDTH (3-NUM, 3-NUM, 2-CHAR)

Enter the radius or length of the plot frame used in cover-frequency sampling to the nearest cm. For example, a rectangular plot frame 50 cm long would be entered as "50.0".

Enter the width of the plot frame used in cover-frequency sampling to the nearest cm if a rectangular plot frame shape is used. Enter "0.0" if a circular plot frame is used.

Enter the unit of measure for plot frame dimensions. For example, CM = centimeters and IN = inch.

Required *Accuracy Standard = No Errors*

COVER CLASS SET

Indicate which cover class set is used: 7 classes ('Daubenmire') or 13 classes ('10-class'). See Figure CF-1.

Required *Accuracy Standard = No Errors*

LIFE FORM (2-CHAR)

Use the following codes to describe the life form of each species.

Required *Accuracy Standard = No Errors*
Source = CSDS: Life forms

CODE	LIFE FORM
T	tree
TR	woody tree
S	shrub
SH	woody shrub
SS	woody sub-shrub
ST	succulent
LI	woody liana
G	grass
GR	herbaceous graminoid
F	forb
FB	herbaceous forb/herb
VI	herbaceous vine
P	pteridophyte (fern and fern allies)
AL	algae
B	bryophyte (mosses and liverworts)
CL	crustose lichen
FO	foliose lichen
FR	fruiticose lichen
FU	fungus

NOTE: Whenever a plant species symbol is required, use the 8-character alpha-numeric codes from the Natural Resource Conservation Service's PLANTS data base. Lists of all species by state are available.

ITEM NAME (8-CHAR)

The cover-frequency data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 75 entries per page. Use as many forms as needed to record all items of interest.

It is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the species symbol can be confused with more than one species.

Acquire ground cover data for each plot frame as the transect is read. Record the average values from the cover-frequency transect on the General Field Data form. The purpose of collecting ground cover data is to describe the ground surface. Interpretations regarding soil surface protection, erosion probability, organic matter contribution, and effects of use such as recreation, grazing, and mechanical activity will be made from this data.

Therefore, the question of whether moss covering a rock should be recorded as "moss" or "rock" is evaluated against the data objective. The result is to record cover as stone, boulder, etc. — whichever describes the soil surface and is what affects the above interpretations. In addition, moss that is growing directly on the soil surface should be recorded as "moss".

As a vegetative entity, the cover of moss should be captured by recording a bryophyte ("B") life form, "MOSS" species, and the appropriate percent cover. Do not record any moss cover more than once.

Required
Accuracy Standard = No error in species level identification for dominant, common, or habitat type indicator plants

AVERAGE CANOPY COVER (3-NUM)

Canopy cover estimates are used to quantify vegetative biomass on the site. The combination of canopy cover with layer descriptions provides a means for making interpretations regarding stand development, seral condition, wildlife cover, and other vegetation dependent characteristics.

For each plant species sampled, divide the summed foliar canopy cover within the transect (SCC) by the number of plot frames sampled on each transect (M/T). Round the resulting quotient to the nearest percent (whole number) for values greater than or equal to 1.0 percent. Round to the nearest tenth of one percent if the average canopy cover is less than 1.0 percent. Enter the average canopy cover for the transect in the column labeled "ACC".

For example, *Poa tracyi* (POTR) is found in 4 of 20 plot frames on a transect. The cover classes recorded are: 1, 3, 2, and 5. Sum the mid-points of each class, then divide by 20 to get the average canopy cover of POTR for the total area sampled (the transect).

$$3.0\% + 37.5\% + 15\% + 85\% = 140.5$$
$$140.5 / 20 = 7\%$$

Required ***Accuracy Standard = ± 10 percent***

PERCENT FREQUENCY (3-NUM)

Divide the number of plot frames in which a given item is present by the total number of plot frames on the transect. Convert that value to a percent by multiplying by 100. In the previous example, the frequency of *Poa tracyi* is:

$$4 / 20 \times 100\% = 20\%$$

Required ***Accuracy Standard = No Errors***

COVER-FREQUENCY INDEX (5-NUM)

Multiply the average canopy cover (ACC) by the percent frequency (% Freq). This value is the cover-frequency index (CFI) and is used in similarity coefficient computations.

$$7\% \times 20\% = 140$$

CANOPY COVER DATA (2-NUM)

For each plant species or selected species in the plot frame, estimate the canopy cover within the plot frame and record the appropriate code to denote that value. *NOTE: Use either traditional "Daubenmire" classes, or "10-classes".*

Required ***Accuracy Standard = ± 1 class***

SUM CANOPY COVER FOR TRANSECT

Total the class midpoints for canopy cover for all plot frames in the transect and record in this space. Midpoint multiplication tables are provided for each cover class set (Table CF-1 and Table CF-2).

Required ***Accuracy Standard = No Errors***

Canopy Cover Classes ("Daubenmire")

CODE	RANGE	MIDPOINT
T	0 - 1.0%	0.5%
1	1.1 - 5.0%	3.0%
2	5.1 - 25.0%	15.0%
3	25.1 - 50.0%	37.5%
4	50.1 - 75.0%	62.5%
5	75.1 - 95.0%	85.0%
6	95.1 - 100.0%	97.5%

Canopy Cover Classes("10-Classes")

CODE	RANGE	MIDPOINT
T	0 - 1.0%	0.5%
0	1.1 - 5.0%	3.0%
1	5.1 - 15.0%	10.0%
2	15.1 - 25.0%	20.0%
3	25.1 - 35.0%	30.0%
4	35.1 - 45.0%	40.0%
5	45.1 - 55.0%	50.0%
6	55.1 - 65.0%	60.0%
7	65.1 - 75.0%	70.0%
8	75.1 - 85.0%	80.0%
9	85.1 - 95.0%	90.0%
A	95.1 - 99.0%	97.0%
X	99.1-100.0%	99.5%

Table CF-1. MIDPOINT MULTIPLICATION TABLE FOR 'DAUBENMIRE' COVER CLASSES

Percent Frequency	Frequency	T	1	2	3	4	5	6
		0.5	3.0	15.0	37.5	62.5	85.0	97.5
5%	1	0.025	0.150	0.750	1.875	3.125	4.250	4.875
10%	2	0.050	0.300	1.500	3.750	6.250	8.500	9.750
15%	3	0.075	0.450	2.250	5.625	9.375	12.750	14.625
20%	4	0.100	0.600	3.000	7.500	12.500	17.000	19.500
25%	5	0.125	0.750	3.750	9.375	15.625	21.250	24.375
30%	6	0.150	0.900	4.500	11.250	18.750	25.500	29.250
35%	7	0.175	1.050	5.250	13.125	21.875	29.750	34.125
40%	8	0.200	1.200	6.000	15.000	25.000	34.000	39.000
45%	9	0.225	1.350	6.750	16.875	28.125	38.250	43.875
50%	10	0.250	1.500	7.500	18.750	31.250	42.500	48.750
55%	11	0.275	1.650	8.250	20.625	34.375	46.750	53.625
60%	12	0.300	1.800	9.000	22.500	37.500	51.000	58.500
65%	13	0.325	1.950	9.750	24.375	40.625	55.250	63.375
70%	14	0.350	2.100	10.500	26.250	43.750	59.500	68.250
75%	15	0.375	2.250	11.250	28.125	46.875	63.750	73.125
80%	16	0.400	2.400	12.000	30.000	50.000	68.000	78.000
85%	17	0.425	2.550	12.750	31.875	53.125	72.250	82.875
90%	18	0.450	2.700	13.500	33.750	56.250	76.500	87.750
95%	19	0.475	2.850	14.250	35.625	59.375	80.750	92.625
100%	20	0.500	3.000	15.000	37.500	62.500	85.000	97.500

Table CF-2. MIDPOINT MULTIPLICATION TABLE FOR '10-CLASSES' COVER CLASSES

Percent Frequency	Frequency	T	0	1	2	3	4	5	6	7	8	9	X	C
		0.5	3.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	97.0	99.5
5%	1	0.025	0.150	0.500	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500	4.850	4.975
10%	2	0.050	0.300	1.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	9.700	9.950
15%	3	0.075	0.450	1.500	3.000	4.500	6.000	7.500	9.000	10.500	12.000	13.500	14.550	14.925
20%	4	0.100	0.600	2.000	4.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000	19.400	19.900
25%	5	0.125	0.750	2.500	5.000	7.500	10.000	12.500	15.000	17.500	20.000	22.500	24.250	24.875
30%	6	0.150	0.900	3.000	6.000	9.000	12.000	15.000	18.000	21.000	24.000	27.000	29.100	29.850
35%	7	0.175	1.050	3.500	7.000	10.500	14.000	17.500	21.000	24.500	28.000	31.500	33.950	34.825
40%	8	0.200	1.200	4.000	8.000	12.000	16.000	20.000	24.000	28.000	32.000	36.000	38.800	39.800
45%	9	0.225	1.350	4.500	9.000	13.500	18.000	22.500	27.000	31.500	36.000	40.500	43.650	44.775
50%	10	0.250	1.500	5.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	48.500	49.750
55%	11	0.275	1.650	5.500	11.000	16.500	22.000	27.500	33.000	38.500	44.000	49.500	53.350	54.725
60%	12	0.300	1.800	6.000	12.000	18.000	24.000	30.000	36.000	42.000	48.000	54.000	58.200	59.700
65%	13	0.325	1.950	6.500	13.000	19.500	26.000	32.500	39.000	45.500	52.000	58.500	63.050	64.675
70%	14	0.350	2.100	7.000	14.000	21.000	28.000	35.000	42.000	49.000	56.000	63.000	67.900	69.650
75%	15	0.375	2.250	7.500	15.000	22.500	30.000	37.500	45.000	52.500	60.000	67.500	72.750	74.625
80%	16	0.400	2.400	8.000	16.000	24.000	32.000	40.000	48.000	56.000	64.000	72.000	77.600	79.600
85%	17	0.425	2.550	8.500	17.000	25.500	34.000	42.500	51.000	59.500	68.000	76.500	82.450	84.575
90%	18	0.450	2.700	9.000	18.000	27.000	36.000	45.000	54.000	63.000	72.000	81.000	87.300	89.550
95%	19	0.475	2.850	9.500	19.000	28.500	38.000	47.500	57.000	66.500	76.000	85.500	92.150	94.525
100%	20	0.500	3.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	97.000	99.500

COVER-FREQUENCY DATA
(R2-2200-CF)

SPATIAL ID FS 02 12 10 373010830 0045 94
PURPOSE/PROJECT TABLE MESA / RED BLUFF
FLORA IDENTIFICATION SOURCE: W86
TRANSECT NUMBER: 1 OF 3
FRAMES/TRANSECT: 20
FLORA IDENTIFICATION LEVEL: 00
TRANSECT LENGTH: 100
FRAME RAD/LEN: 50.0
UNIT OF MEASURE: FT
FRAME WIDTH: 20.0
COVER CLASS: : ✓ "6" OR ___ "10"
UNIT OF MEASURE: CM

			ACC x % Freq = CFI			Canopy Cover Data																				
	LF	Item	ACC	% Freq	CFI	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	SCC
1	T	POTR5																								
2	T	SABE2																								
3	S	ARTRV	17	50	850							2	5		3	3		3		2	2		4	2	2	335
4	S	SYOR2																								
5	S	CHNA2	0.8	10	8												T						2			15.5
6	S	CHVI8	2	15	30					1	3						T									41
7	S	RILA																								
8	S	SARA2																								
9	G	FETH	2	5	10		3																			37.5
10	G	CAEL3	2	10	20													2	2							30
11	G	POPR	10	50	500	2	2		2	2	2	3			2	3				2			2			195
12	G	PONE2	44	75	3300	4	5	5	6	4	2	3	5	5	4	2	4				3	4	2			870
13	G	CAGE2																								
14	G	KOMA	2	10	20	2	2																			30
15	G	CAFI																								
16	G	KOCR	0.8	5	4																2					15
17	G	PASM	5	15	75													2		3			3			90
18	G	BROMU	3	15	45														2					2	3	67.5
19	F	ACLA5	25	80	2000	4	4	2	2	3	3	2	2	2		3			4	2	2	4	2	2		497.5
20	F	TAOF	21	80	1680			2		2	3	2	T		2	2	2	3	3	2	4	2	2	5	2	410.5
21	F	MEFU2	6	45	270	2	2	2			2		T			2	2	2	2							120.5
22	F	LATHY	11	50	550		2		2	2	2	2	4			2	2					2	3			220
23	F	VIAM	10	30	300															2	2	3	3	T	5	190.5
24	F	DEBA2	6	55	330			2			2			2	2	2	2		2		T	T	T		2	121.5
25	F	RAGL	2	15	30										2		2		2							45
26	F	NOMO2	0.8	5	4												2									15
27	F	ANSE4	0.8	5	4													2								15
28																										
29																										
30																										
Rq	Z	**WOOD**	0.9	20	18		T										T		1	2						19
Rq	Z	**LITTER/DUFF**	50	100	5000	4	3	4	3	5	2	2	4	3	4	3	5	4	3	2	4	3	5	4	3	1000
Rq	Z	**MOSS/LICHEN**	5	65	325	T	T		T	T	2				2			T	3	2	T	1		T	1	92
Rq	Z	**BASAL VEG**	2	100	200	T	1	T	2	T	T	1	T	T	T	T	1	1	T	T	T	T	1	1	T	39.5
Rq	Z	**WATER**																								
Rq	Z	**BARE SOIL <2mm**	33	100	3300	2	3	3	3	2	4	5	3	4	2	3	1	3	2	2	3	4	1	3	1	656.5
Rq	Z	**GRAVEL 2mm-3in**	4	45	180	2	1	T			1					2	T		1					T	3	78
Rq	Z	**COBBLE 3-10in**	1	25	25		2						T			1		1							1	24.5
Rq	Z	**STONE 10-24in**	2	10	20												T			3						38
Rq	Z	**BOULDER >24in**	0.2	10	2	1									T											3.5
Rq	Z	**BEDROCK**																								

T	0 - 1.0% cover	**0.5%**	2	5.1 - 25.0% cover	**15.0%**	4	50.1 - 75.0% cover	**62.5%**	6	95.1 - 100.0% cover	**97.5%**
1	1.1 - 5.0% cover	**3.0%**	3	25.1 - 50.0% cover	**37.5%**	5	75.1 - 95.0% cover	**85.0%**			

COVER-FREQUENCY DATA
(R2-2200-CF)

SPATIAL ID FS 02 12 10 373010830 0045 94

			ACC x % Freq = CFI			Canopy Cover Data																				
	LF	Item	ACC	% Freq	CFI	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	SCC
31																										
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T	0 - 1.0% cover	**0.5%**	2	5.1 - 25.0% cover	**15.0%**	4	50.1 - 75.0% cover	**62.5%**	6	95.1 - 100.0% cover	**97.5%**
1	1.1 - 5.0% cover	**3.0%**	3	25.1 - 50.0% cover	**37.5%**	5	75.1 - 95.0% cover	**85.0%**			

COVER-FREQUENCY SUMMARY
(R2-2200-CFSum)

SPATIAL ID FS 02 12 10 373010830 0045 94

PURPOSE/PROJECT TABLE MESA / RED BLUFF

FLORA IDENTIFICATION SOURCE: W86

FLORA IDENTIFICATION LEVEL: 00

TRANSECT NUMBER: 1 OF 3

TRANSECT LENGTH: 100

UNIT OF MEASURE: FT

FRAMES/TRANSECT: 20

FRAME RAD/LEN: 50.0

FRAME WIDTH: 20.0

UNIT OF MEASURE: CM

COVER CLASS: : ✓ "6" OR ___ "10"

	LF	Item	Transect 1			Transect 2			Transect 3			Transect 4			Transect 5			Transect 6		
			ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI
1	T	POTR5																		
2	T	SABE2																		
3	S	ARTRV	17	50	850				2	15	30									
4	S	SYOR2				0.2	5	1												
5	S	CHNA2	0.8	10	8	25	30	750	10	30	300									
6	S	CHVI8	2	15	30															
7	S	RILA																		
8	S	SARA2																		
9	G	FETH	2	5	10	10	50	500												
10	G	CAEL3	2	10	20															
11	G	POPR	10	50	500	20	50	1000	6	10	60									
12	G	PONE2	44	75	3300	35	20	700	10	50	500									
13	G	CAGE2																		
14	G	KOMA	2	10	20				0.2	5	1									
15	G	CAFI				0.8	5	4												
16	G	KOCR	0.8	5	4				2	10	20									
17	G	PASM	5	15	75															
18	G	BROMU	3	15	45	20	15	300												
19	G	ELEL5				0.8	5	4												
20	F	ACLA5	25	80	2000	10	20	200	35	30	1050									
21	F	TAOF	21	80	1680	10	30	300	25	80	2000									
22	F	MEFU2	6	45	270				6	45	270									
23	F	LATHY	11	50	550	10	10	100	16	20	320									
24	F	VIAM	10	30	300	2	15	30												
25	F	DEBA2	6	55	330															
26	F	RAGL	2	15	30				0.8	5	4									
27	F	NOMO2	0.8	5	4				2	15	30									
28	F	ANSE4	0.8	5	4	5	5	25												
29	F	GASE6							2	15	30									
30	F	ERIOG																		
Rq	Z	**WOOD**	0.9	20	1.8															
Rq	Z	**LITTER/DUFF**	50	100	5000	33	100	3300	68	100	6800									
Rq	Z	**MOSS/LICHEN**	5	65	325	4	45	180	2	10	20									
Rq	Z	**BASAL VEG**	1	100	100	1	100	100	1	100	100									
Rq	Z	**WATER**																		
Rq	Z	**BARE SOIL**	33	100	3300	50	100	5000	25	30	750									
Rq	Z	**GRAVEL**	4	45	180	0.1	10	1	5	65	325									
Rq	Z	**COBBLE**	1	25	25	2	10	20	2	10	20									
Rq	Z	**STONE**	2	10	20															
Rq	Z	**BOULDER**	0.2	10	2															
Rq	Z	**BEDROCK**																		

COVER-FREQUENCY SUMMARY
(R2-2200-CFSum)

SPATIAL ID FS 02 12 10 373010830 0045 94

			Transect 1			Transect 2			Transect 3			Transect 4			Transect 5			Transect 6		
	LF	Item	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI
31	F	PHMU3				0.8	5	4												
32	F	ANAM							0.8	5	4									
33																				
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EXHIBIT LI: LINE INTERCEPT

R2-2200-LI

GENERAL DISCUSSION

This sampling method is primarily used to record shrub species foliar canopy cover. Line intercept is normally used in conjunction with cover-frequency transects when vegetation over 3.5 feet tall exists. It is commonly used to provide quantitative, replicated measurements of plant species cover for monitoring purposes. It is also used to calibrate ocular estimates of shrub cover when crews are unfamiliar with the Ocular Plant Composition method.

Shrub density data is collected along with information on the form and age class of the various shrubs present. This information provides additional data for evaluating condition or trend in the shrub community, and is especially important where some form of cultural treatment has been done and/or where the shrub component is important.

ADVANTAGES AND LIMITATIONS

It provides more precise determinations of canopy cover than ocular assessments. This method is especially useful for quantification of shrub cover greater than 3.5 feet tall, given that ocular estimation of cover for such species is difficult.

Shrub density information is relatively easy to obtain. The collected data provides additional information about changes in the shrub component of the plant community.

Line intercept is fast, accurate, and relatively free of bias. However, unless specific standards are employed, it may be difficult to obtain consistent results, especially where plants have open crowns. *This problem can be avoided by ignoring any holes or openings in the crown and measuring along the perimeter of the live canopy that bisects the transect line.* This technique may be difficult to use in dense stands with several species where the canopy of one species overlaps another.

TRAINING

Examiners must be knowledgeable in plant identification.

PERSONNEL AND EQUIPMENT

Equipment required for this method includes a 100-foot tape (marked in feet and tenths of feet), temporary stakes to hold the tape, camera, Robel pole for photograph scale, and permanent stakes if the plot is to be established permanently. All shrubs (or measured plants) encountered along the transect are dot tallied by species and classified according to form and age class. ***Two forms must be completed: General Field Data Form (R2-2200-GF) and Line Intercept Data Form (R2-2200-LI).***

SAMPLING PROCEDURE

Line intercept basically consists of an established line transect, usually of 100 feet, where measurements are made of the canopy cover of various plants that are bisected by the line. These intercept measurements are recorded by species to the nearest 0.10 foot on Form R2-2200-LI. They provide an estimate of relative cover for each plant species present on the study site.

NUMBER OF TRANSECTS

If the line intercept procedure is used in conjunction with cover-frequency transects, the number and placement of the transect lines should coincide with those established for the cover-frequency study. If using the line intercept method by itself, the number of transects needed to get a reliable sample of a site should be no less then three but may be as many as ten or more.

ESTABLISHMENT OF LINE TRANSECTS

A 100-foot tape is stretched and anchored at the ends. The tape should be as close to the ground as possible while keeping it straight and enabling the investigator to measure the intercept of all the plants.

RECORDING SHRUB INTERCEPT

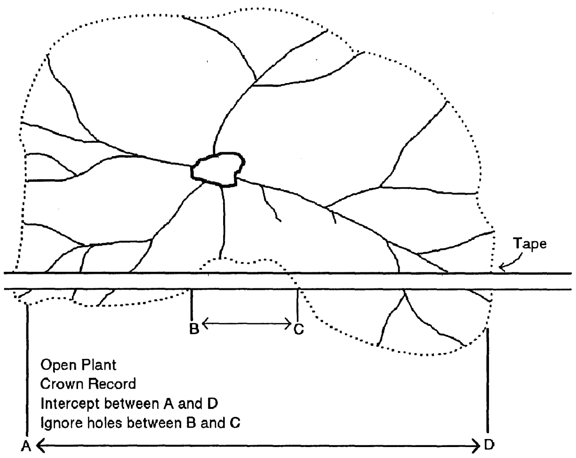
Once photos are taken, the next step is to measure where the tape intercepts the live canopy. Where necessary, a plumb bob can be used in making these intercept measurements. Measurements are made to the nearest 0.10 foot.

The procedure for measuring the live crown intercept bisected by the transect line is illustrated in Figure LI-1, Figure LI-2, and Figure LI-3. Use Form R2-2200-LI. Where shrubs are monitored individually on permanent transects, the actual intercept (the position of the shrub along the 100-foot tape, for example, 3.5-5.1 feet) must be recorded. In addition to the line intercept measurement, form and age class should also be recorded.

SUMMARIZING DATA

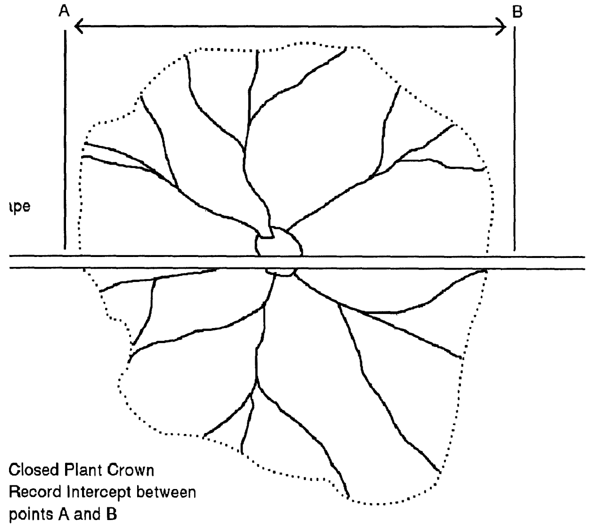
After all line intercept measurements are taken, the actual intercept should be totaled by species at the bottom of the form. Compile the results from each line, calculating percentages for cover and composition.

Figure LI-1. MEASURING SHRUB INTERCEPT



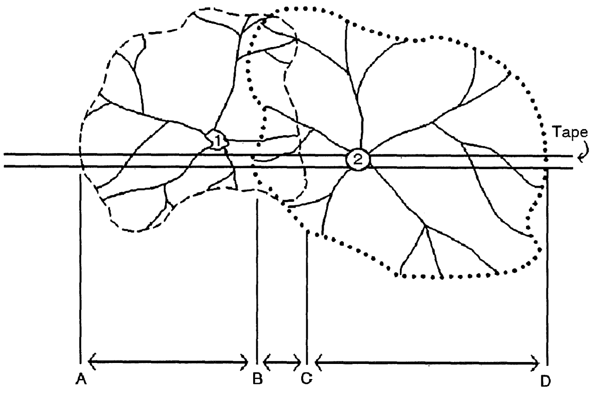
Open Plant
Crown Record
Intercept between A and D
Ignore holes between B and C

Figure LI-2. MEASURING SHRUB INTERCEPT



Closed Plant Crown
Record Intercept between
points A and B

Figure LI-3. MEASURING SHRUB INTERCEPT



Overlapping Growth:

If plants are of the same species, record intercept between A and D. If they are different species, record the intercept of the first species between points A-C and between B-D for the second species.

FORM DESCRIPTION
R2-2200-LI and R2-2200-Sum

There is room for 10 species on field forms R2-2200-LI and R2-2200-LISum; however, there is no limit to the number of items that can be sampled and entered into the data base. Consequently, use as many forms as needed to sample all items of interest in the study. The information from R2-2200-LI is summarized on R2-2200-LISum.

SPATIAL IDENTIFIER (23-CHAR)

Enter the Spatial ID identified in field 1 of the General Field Data Form (R2-2200-GF).

Required ***Accuracy Standard = No Errors***

PURPOSE (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the next (Project) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional ***Accuracy Standard = No Errors***

PROJECT (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the previous (Purpose) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional ***Accuracy Standard = No Errors***

MINIMUM HEIGHT (3-NUM)

Record minimum height of species observed on line intercept. Value should be to nearest tenth of a unit.

Required ***Accuracy Standard = ±.10 unit***

MAXIMUM HEIGHT (4-NUM)

Record maximum height of species observed on line intercept. Value should be to nearest tenth of a unit.

Required ***Accuracy Standard = ±.10 unit***

UNIT OF MEASURE (2-CHAR)

Record unit for height measurements. For example, FT = feet and M = meters.

Required ***Accuracy Standard = No Errors***

NUMBER OF TRANSECTS (2-NUM, 2-NUM)

Identify which transect this form is for by identifying transect number “x” of “y” where “x” is the transect number and “y” is the total number of transects in the sample, usually two. This number cannot exceed ten.

Required ***Accuracy Standard = No Errors***

TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required ***Accuracy Standard = No Errors***

UNIT OF MEASURE (2-CHAR)

Enter unit of measure for transect length. For example, FT = feet and M = meters.

Required ***Accuracy Standard = No Errors***

LIFE FORM (2-CHAR)

Use the following codes to describe the life form of each species.

Required ***Accuracy Standard = No Errors***
Source = CSDS: Life forms

CODE	LIFE FORM
T	tree
TR	woody tree
S	shrub
SH	woody shrub
SS	woody sub-shrub
ST	succulent
LI	woody liana
G	grass
GR	herbaceous graminoid
F	forb
FB	herbaceous forb/herb
VI	herbaceous vine
P	pteridophyte (fern and fern allies)
AL	algae
B	bryophyte (mosses and liverworts)
CL	crustose lichen
FO	foliose lichen
FR	fruiticose lichen
FU	fungus

NOTE: Whenever a plant species symbol is required, use the 8-character alpha-numeric codes from the Natural Resource Conservation Service's PLANTS data base. Lists of all species by state are available.

SPECIES 1-10 (8-CHAR) [R2-2200-LI]

Enter species code of plants encountered on the line intercept. Use more than one form if necessary. The total intercept length from the bottom of the form is entered on R2-2200-LISum. Be sure to indicate the age or size class of the species.

Required ***Accuracy Standard = No Errors***

TOTAL 1-10 (3-NUM)

Sum the total length of intercept encountered for each species. Transfer these values to R2-2200-LISum for data entry.

PLANT NAME (8-CHAR) [R2-2200-LISUM]

The data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 10 entries per page. Use as many pages of Form R2-2200-LI as needed to record all items of interest in sampling.

It is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the species symbol can be confused with more than one species.

Required
Accuracy Standard = No error in species level identification for dominant, common, or habitat type indicator plants

AGE OR SIZE CLASS CODES (2-CHAR)

Enter one of the following codes to denote the age or size class of an item in line intercept sampling.

This field allows the examiner to distinguish between age or size classes for the same item by providing a separate line of data for different age or size classes. Item names may be repeated, therefore, only if the accompanying age or size classes differ. Other classes may be substituted for age or size class, such as categories for structure and hardness of snags or downed logs. Such classes must be specific to a given study and should be recorded in the appropriate project file as well as noted on the Comments Form (R2-2200-CD).

Optional ***Accuracy Standard = No Errors***

COVER DATA BY TRANSECT (3-NUM)

Enter the sum of live foliar canopy cover, in tenths of feet, intercepted by the transect by plant species (item) for up to 10 transects. Do not differentiate between plants above and below the transect tape. Total feet of intercept are recorded by plant species and line transect. The total recorded cannot exceed the length of the transect and does not include overlap of the same species along the transect.

Required ***Accuracy Standard = ± 5 percent***

AGE AND SIZE CLASSES

LIFE FORM	CODE	COLUMN DESCRIPTION
Coniferous Tree Species	SE	Seedling trees (< 1.0 in DBH or < 4.5 ft tall)
	SA	Sapling trees (1.0 - 4.9 in DBH)
	PT	Pole trees (5.0 - 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Broadleaf Tree Species	LL	Lower layer seedlings, sprouts, and saplings (< 2.5 ft tall)
	ML	Middle layer sprouts & saplings (2.5 - 6.5 ft tall)
	SP	Sapling and pole trees (≥ 6.5 ft tall and ≤ 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Shrub Species Size Class	LS	Lower layer (≥ 1 yr old and < 2.5 ft tall)
	MS	Middle layer (2.5 - 6.5 ft tall)
	TS	Upper layer (≥ 6.5 ft tall)
Herbaceous or Shrub Species Age Class	SE	Seedlings (< 1 yr old)
	RS	Regrowth and sprouts (< 1 yr old)
	YO	Young (≥ 1 yr old without accumulate litter and < 10% dead material)
	MA	Mature (accumulated litter present and dead material present is 10-25%)
	DE	Decadent (≥ 50% dead material)

AGE CLASSES

To ensure consistency in classifying and recording shrubs by form and age class, the following definitions should be used:

SEEDLING (SPROUTS) (S)

A very young plant that has become firmly established yet obviously is a newcomer on the site (first-year seedlings are ignored). It is usually distinguished by its relatively small size, generally single stem, simple or no branching, succulent bark, less than 1/8-inch diameter at the base, and does not possess a large root stock (sprouts may be an exception). No evidence of flowering or seed production.

YOUNG (Y)

A relatively young plant, larger than a sprout or seedling (1/8-inch to 1/2-inch diameter at the base, varying with species) with more complex branching, may possess multiple basal stems but is attached to a relatively small root stock (except for saplings), and bark is more fibrous than seedlings but is not fissured as with a mature plant. Crowns are not rounded and are made up of all living wood. May or may not show signs of flowering and seed production.

MATURE (M)

A mature plant exhibits complex branching and multiple stems, fibrous fissured bark, rounded growth form, large, heavy, often gnarled stems and a firmly established predominant root stock. The root crown is made up of three-quarters or more living wood. Evidence of flowering and or seed production is present.

DECADENT (D)

A mature plant that possesses more than 50 percent dead wood in the crown.

DEAD (X)

A plant that obviously does not possess any live crown, but the root is still firmly attached (downed, unattached, woody stems are considered litter).

FORM CLASSES

The form classes are based on availability of browse plants and their degree of hedging. These factors along with age structure can assist in determining the relative health of a browse stand and can aid in evaluating trend.

Availability represents the relative amount of twig growth that is within reach of grazing animals. Snow depth or duration will have no bearing on availability, as defined in this Guide. Hedging is the result of repeated utilization and is one of the factors that affects availability of shrubs. The general appearance of the plant is a primary criterion in determining degree of hedging.

The following descriptions are provided as an aid to classifying shrub availability.

ALL AVAILABLE

This category signifies that all of the current year's twig growth is within reach of grazing animals. This type of plant is generally represented by an open crown.

LARGELY AVAILABLE

The bulk of the vegetation in this category is available to the class of herbivores present in the area. A small portion of the current year's growth is unavailable due to: large crowns, moderate to heavy hedging, shrub height, steep terrain, and stand density.

MOSTLY UNAVAILABLE

A large portion of current year's growth is not available for grazing. This may be due to one or more of the reasons mentioned in the largely available category above.

UNAVAILABLE

These shrubs may produce large quantities of twig growth; however, it is not available to grazing animals. Frequently, a tall growth form places shrubs in this category. A hedgeline is also common where shrubs have become unavailable. Dead or decadent plants often fall in this category.

HEDGING CATEGORIES

Within the "all available" and "largely available" form classes, indicate the status of the hedging with one of the following categories.

LIGHTLY HEDGED

Shrubs of this nature generally have open, loose crowns and produce a large quantity of vigorous twigs. Frequently, these plants are either all or largely available. Their appearance is that of healthy, fast-growing plants. Unhedged plants are included here.

MODERATELY HEDGED

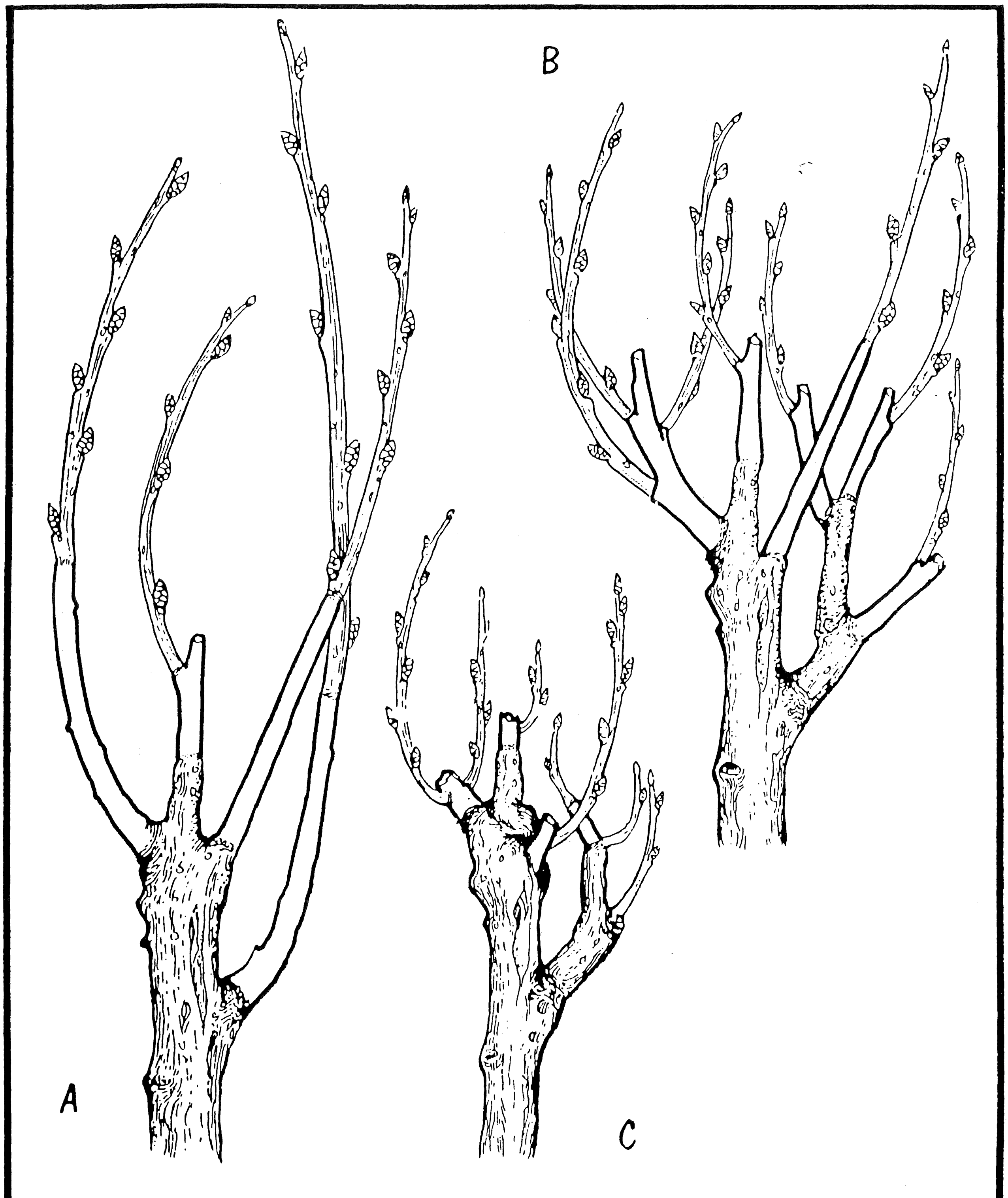
These shrubs possess moderately open crowns but show signs of some clubbing. Plants that are hedged to this degree exhibit varying levels of vigor and begin to take on a ragged appearance. Some of the twigs are readily available while the remaining twig growth is generally unavailable due to the tight growth forms and presence of larger clubbed stems on the periphery of the crown.

CLOSELY HEDGED

A closed, compact rounded appearance is usually characteristic of this degree of hedging on a mature plant. Generally, very little twig growth is present on the exterior portion of the shrub; most of the twig growth is confined to the interior.

A decadent plant often shows signs of close hedging on the few larger stems that produce limited leader growth. Young plants are generally not very common in a closely hedged shrub community. A diagram of hedging classes is shown in Figure LI-4.

Figure LI-4. DEGREE OF HEDGING



A. Zero to light, B. Moderate, C. Severe

LINE INTERCEPT COVER
(R2-2200-LI)

SPATIAL ID FS 02 12 10 373010830 0045 94
PURPOSE/PROJECT TABLE MESA / RED BLUFF
MINIMUM HEIGHT: 3
MAXIMUM HEIGHT: 10
UNIT OF MEASURE: FT
TRANSECT NUMBER: 1 OF 3
TRANSECT LENGTH: 100.0
UNIT OF MEASURE: FT

Spp 1: **ARTRV**			Spp 2: **SYRO**			Spp 3: **ROWO**			Spp 4:			Spp 5:		
Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt
2.1	**3.1**	**1.0**	**3.9**	**4.7**	**0.8**	**15.2**	**17.3**	**2.1**						
6.8	**9.1**	**2.3**	**15.1**	**18.1**	**3.0**									
23.0	**26.4**	**3.4**	**35.2**	**36.4**	**1.2**									
42.5	**44.5**	**2.0**	**61.1**	**64.0**	**2.9**									
59.8	**63.2**	**3.4**												
80.1	**84.0**	**3.9**												
98.0	**100.0**	**2.0**												
	Total=	18.0		Total=	7.9		Total=	2.1		Total=			Total=	

Species	Age Class					Form Class						Mostly Unavailable	Unavailable
	S	Y	M	D	X	All Available			Largely Avail.				
	Seedling Sprout	Young Sapling	Mature	Decadent	Dead	Lightly Hedged	Moder. Hedged	Closely Hedged	Lightly Hedged	Moder. Hedged	Closely Hedged		
ARTRV	2		7			9							
SYOR	1		3			4							
ROWO			1										

LINE INTERCEPT COVER
(R2-2200-LI)

SPATIAL ID FS 02 12 10 373010830 0045 94
PURPOSE/PROJECT TABLE MESA / RED BLUFF

Spp 6:			Spp 7:			Spp 8:			Spp 9:			Spp 10:		
Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt
	Total=			Total=			Total=			Total=			Total=	

Species	Age Class					Form Class						Mostly Unavailable	Unavailable
	S	Y	M	D	X	All Available			Largely Avail.				
	Seedling Sprout	Young Sapling	Mature	Decadent	Dead	Lightly Hedged	Moder. Hedged	Closely Hedged	Lightly Hedged	Moder. Hedged	Closely Hedged		

LINE INTERCEPT SUMMARY

(R2-2200-LISum)

SPATIAL ID FS 02 12 10 373010830 0045 94
PURPOSE/PROJECT TABLE MESA / RED BLUFF
MINIMUM HEIGHT: 3
MAXIMUM HEIGHT: 10
UNIT OF MEASURE: FT
TRANSECT NUMBER: 1 OF 3
TRANSECT LENGTH: 100.0
UNIT OF MEASURE: FT

	LF	Plant Name	A/S	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Ave Intrcpt
1	S	ARTRV	MS	18	12									15
2	S	SYRO	MS	8	14									11
3	S	ROWO	MS	2										1
4														
5														
6														
7														
8														
9														
10														

Species	Age Class					Form Class						Mostly Unavailable	Unavailable
	S	Y	M	D	X	All Available			Largely Avail.				
	Seedling Sprout	Young Sapling	Mature	Decadent	Dead	Lightly Hedged	Moder. Hedged	Closely Hedged	Lightly Hedged	Moder. Hedged	Closely Hedged		

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EXHIBIT PD: PRODUCTION MEASUREMENTS
R2-2200-PD

GENERAL DISCUSSION

As part of both inventory and monitoring, a key measurement is forage production. Forage production estimates should be made for each common vegetation unit. In addition to total forage production, data can be collected by selected species or life form as needed. The most practicable way to do this is a combination of clipping and weighing forage and then using that measurement to calibrate ocular estimates to expand the sample size. Production measurements are normally optional. The exception is when capacity is being determined for the first time. Then it is important to measure the production.

TRAINING

Examiners must be knowledgeable in plant identification. In addition, they must be experienced in providing ocular estimates of production data.

PERSONNEL AND EQUIPMENT

Equipment required for this sampling method includes the appropriate plot frame (see Table PD-1), a gram scale, clippers, and paper bags. Use the Production Data Form (R2-2200-PD) for sampling and calculating production. *NOTE: Circular plots of 9.6 feet*^{2} *should be used to sample sparsely vegetated sites; 0.96 feet*^{2} *circular plots should be used on densely vegetated sites.*

SAMPLING PROCEDURE

This method is applicable for both grazed and ungrazed areas. It is preferable to estimate production in ungrazed areas.

CLIPPING AND WEIGHING

Forage will be clipped as close to the ground as possible, and weighed using a gram scale. Frame sizes and conversion factors are Table PD-1). All production estimates should be corrected to give air-dry forage produced. Table PD-2 provides factors for converting green, field weights to air-dry weights. When precise production measurements are required, air-dry the clipped vegetation and do not use the conversion factors in Table PD-2.

Actual air-dry measurements are more accurate than using conversion factors. Typically, all forage species are lumped together to get a total forage production estimate for carrying capacity determinations. There may be times when plants are separated by species or life form to meet specific management needs.

To determine forage production on grazed areas, it is necessary to adjust the estimate of forage remaining by the degree of utilization. This is done by using the following equation:

$$\frac{\text{Weight of Forage Remaining}}{\text{Estimated Percent Remaining (use deicmal)}} = \text{Total Production}$$

After minimum training, reliable ocular estimates of relative forage production can be obtained.

Table PD-1. PRODUCTION CONVERSION FACTORS

			Multiply grams weighed in order to determine:[9]	
Plot frame			lbs/ac	kg/ha
Rectangle:	20x50 cm.	(.1 m^2)	89.2	100.0
Square:	50x50 cm.	(.25 m^2)	35.7	40.0
Circle:	radius 6.6 in	(0.96 ft^2)[10]	100.0	112.9
Circle:	radius 21.0 in	(9.6 ft^2) [11]	10.0	11.2

---

[9] g/ha x .9 = lbs/ac

[10] The 0.96 ft^2 circle can be constructed by using 41.7 in of cable.

[11] The 0 9.6 ft^2 circle can be constructed by using 131.8 in of cable.

Table PD-2. PERCENTAGE OF AIR-DRY MATTER IN HARVESTED PLANT MATERIAL AT VARIOUS STAGES OF GROWTH

SHRUBS	New leaf/twig growth until leaves full size	Older and full-size green leaves	Green fruit	Dry fruit	
Evergreen big sagebrush, bitterbrush	55%	65%	35%	85%	
Deciduous snowberry, rabbitbrush, snakeweed Gambel oak	35%	50%	30%	85%	
Yucca and Yucca-like plants	55%	65%	35%	85%	
FORBS	Initial growth to flowering	Flowering to seed maturity	Seed ripe; leaf tips dry	Leaves dry; stems drying	Dry
Succulent violet, cow parsnip, waterleaf, buttercup, bluebells, ligusticum, sweet-anise, onion, lilies, monkshood	15%	35%	60%	90%	100%
Leafy lupine, balsamroot, and others	20%	40%	60%	90%	100%
Fibrous leaves or mat phlox, pussytoes, mat eriogonum	30%	50%	75%	90%	100%
GRASSES	Before heading; initial growth to boot stage	Headed out; boot stage to flowering	Seed ripe; leaf tips dry	Leaves dry; stems partly dry	Apparent dormancy
Cool Season wheat grasses, perennial bromes, bluegrasses, needlegrasses, prairie junegrass	35%	45%	60%	85%	95%
Warm Season Tall grasses big bluestem, indiangrass, switchgrass	30%	45%	60%	85%	95%
Mid grasses side-oats grama, little bluestem, galleta	40%	55%	65%	90%	95%
Short grasses blue grama, buffalograss, short tree-awn	35%	45%	60%	85%	95%

ROBEL POLE USE

Visual readings from a Robel pole can be correlated to forage production or standing crop by clipping and weighing forage on a sample after making the Robel pole readings. Care must be taken to understand that use of a pole will provide an estimate of *standing biomass.* This will include not only this year's production, but also any herbage remaining from prior years. After the correlation is made between the Robel pole reading and production, the Robel pole can be used to quickly and efficiently expand the sample size for production on a specific plant community. (Reference the Robel pole section, page 4-23.) This method has a lot of potential for Forest Service rangelands and will be the focus of research studies in the future.

FORM DESCRIPTION

R2-2200-PD and R2-2200-PDSum

If production plot frames are sampled along transects, the field form (R2-2200-PD) allows no more than 20 plot frames per transect to be recorded. Each page of Form R2-2200-PD accommodates up to 40 items; however, the data base can accommodate as many entries as you require. Use as many forms as needed to record all items of interest.

SPATIAL IDENTIFIER (23-CHAR)

Enter the Spatial ID identified in Field 1 of the General Field Data Form (R2-2200-GF).

Required ***Accuracy Standard = No Errors***

PURPOSE (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the next (Project) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional ***Accuracy Standard = No Errors***

PROJECT (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the previous (Purpose) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional ***Accuracy Standard = No Errors***

NUMBER OF TRANSECTS (2-NUM, 2-NUM)

Identify which transect this form is for by identifying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually two. This number cannot exceed ten.

Required ***Accuracy Standard = No Errors.***

TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required ***Accuracy Standard = No Errors***

UNIT OF MEASURE (2-CHAR)

Enter unit of measure for transect length. For example, FT = feet and M = meters.

Required. ***Accuracy Standard = No Errors***

NUMBER OF FRAMES PER TRANSECT (2-NUM)

Enter the number of plot frames used to record production along a transect. This number must be the same for each transect.

Required ***Accuracy Standard = No Errors***

FRAME RADIUS OR LENGTH, AND WIDTH (3-NUM, 3-NUM, 2-CHAR)

Enter the radius or length of the plot frame used in cover-frequency sampling to the nearest cm. For example, a rectangular plot frame 50 cm long would be entered as "50.0".

Enter the width of the plot frame used in cover-frequency sampling to the nearest cm if a rectangular plot frame shape is used. Enter "0.0" if a circular plot frame is used.

Enter the unit of measure for plot frame dimensions. For example, CM = centimeters and IN = inch.

Required ***Accuracy Standard = No Errors***

CONVERSION FACTOR (4-NUM)

Enter the conversion factor from Table PD-1, based on the frame size.

Optional ***Accuracy Standard = No Errors***

LIFE FORM (2-CHAR)

Use the following codes to describe the life form of each species.

Required ***Accuracy Standard = No Errors***
Source = CSDS: Life forms.

CODE	LIFE FORM
T	tree
TR	woody tree
S	shrub
SH	woody shrub
SS	woody sub-shrub
ST	succulent
LI	woody liana
G	grass
GR	herbaceous graminoid
F	forb
FB	herbaceous forb/herb
VI	herbaceous vine
P	pteridophyte (fern and fern allies)
AL	algae
B	bryophyte (mosses and liverworts)
CL	crustose lichen
FO	foliose lichen
FR	fruiticose lichen
FU	fungus

NOTE: Whenever a plant species symbol is required, use the 8-character alpha-numeric codes from the Natural Resource Conservation Service's PLANTS data base. Lists of all species by state are available.

SPECIES (8-CHAR)

The production data base can accommodate as many items as were sampled on as many as 10 transects, even though the field form only allows 35 entries per page. Use as many pages of R2-2200-PD as you need to record all items of interest. If an item is encountered on at least one transect, ensure that it is consequently recorded on all other transects even though its production may only be "0".

During the transition period between using other species coding systems and the NRCS PLANTS data base codes, it is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the code species symbol can be confused for more than one species.

If more than one transect is sampled, enter plot frames in consecutive order by transect and use a separate R2-2200-PD for each transect.

Required
Accuracy Standard = No error in species level identification for dominant, common, ecological indicator plants

AGE OR SIZE CLASS CODES (2-CHAR)

Enter one of the following codes to describe the age or size class of each species recorded.

This field allows the examiner to distinguish between age and size classes for the same item by providing a separate line of data for different age or size classes. Item names may be repeated, therefore, only if the accompanying age or size classes differ. Other classes may be substituted for age or size class, such as categories for structure or phenology. Such classes must be specific to a given study and should be recorded in the appropriate project file, as well as noted on the Comments Form (R2-2200-CD).

Optional ***Accuracy Standard = No Errors***

PRODUCTION DATA

For each plot frame use a bag, gram scale, and clippers to weigh units of green (current year's growth) above ground biomass by item. Estimate the grams green weight, by item, for the whole plot frame. All green biomass that hangs over the plot frame is included in such estimates. Tree and shrub biomass above 6.5 feet height is not included in production estimates.

Individual plot frame green weight production data are not entered into the data base. They are converted to dry weight values as described in Table PD-2. Enter dry weight values in these fields if actual dry-weight measurements are made.

Required ***Accuracy Standard = ± 10 percent***

AGE AND SIZE CLASSES

LIFE FORM	CODE	COLUMN DESCRIPTION
Coniferous Tree Species	SE	Seedling trees (< 1.0 in DBH or < 4.5 ft tall)
	SA	Sapling trees (1.0 - 4.9 in DBH)
	PT	Pole trees (5.0 - 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Broadleaf Tree Species	LL	Lower layer seedlings, sprouts, and saplings (< 2.5 ft tall)
	ML	Middle layer sprouts & saplings (2.5 - 6.5 ft tall)
	SP	Sapling and pole trees (≥ 6.5 ft tall and ≤ 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Shrub Species Size Class	LS	Lower layer (≥ 1 yr old and < 2.5 ft tall)
	MS	Middle layer (2.5 - 6.5 ft tall)
	TS	Upper layer (≥ 6.5 ft tall)
Herbaceous or Shrub Species Age Class	SE	Seedlings (< 1 yr old)
	RS	Regrowth and sprouts (< 1 yr old)
	YO	Young (≥ 1 yr old without accumulate litter and < 10% dead material)
	MA	Mature (accumulated litter present and dead material present is 10-25%)
	DE	Decadent (≥ 50% dead material)

AVERAGE GREEN WEIGHT

Total the green weight values for all plot frames, divide by the total number of plot frames on the transect, and enter the value in this field.

Required *Accuracy Standard = ± 10 percent*

DRY WEIGHT FACTOR

Enter an appropriate dry weight factor (that is, decimal between 0 and 1) to convert plot frame green weight estimates (GW) to dry weight by item. Dry weight factors are provided by life form in Table PD-2. If the same dry weight factor is used for an item over all the plot frame sampled, enter it once in the space provided for the first plot frame. If actual dry-weight measurements are made, enter "1.00" in this field

Optional *Accuracy Standard = Good Judgment*

AVERAGE TOTAL PRODUCTION (4-NUM)

Enter the average measured, or converted, dry weight production (in grams) for each item. Dry weight is obtained by multiplying the average green weight (GW) by the appropriate dry weight conversion factor (DWF).

Required *Accuracy Standard = ± 10 percent*

PRODUCTION DATA BY TRANSECT (3-NUM)

Enter the dry weight production on R2-2200-LISum for each plant species (item) on each of a maximum of 10 transects. Enter production values in grams.

Required *Accuracy Standard = ± 10 percent*

PRODUCTION DATA
(R2-2200-PD)

SPATIAL ID FS 02 12 10 373010830 0045 94

PURPOSE/PROJECT TABLE MESA / RED BLUFF

TRANSECT NUMBER: 1 OF 3

FRAMES/TRANSECT: 20

TRANSECT LENGTH: 100

FRAME RAD/LEN: 0.96

UNIT OF MEASURE: FT

FRAME WIDTH: ___

CONVERSION FACTOR: 100.0

UNIT OF MEASURE: CM

	LF	Species	A/S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Avg GW	DWF	Avg Prod
1	G	GRASS	MA	48	92	67	31	40	35	59	80	16	59	45	82	60	45	49	51	62	28	42	91	54	0.6	32
2																										
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Total Prod	32
Conv Factor	x 100
Tot Lbs/Ac	3200

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PRODUCTION DATA SUMMARY
(R2-2200-PDSum)

SPATIAL ID FS 02 12 10 373010830 0045 94

TRANSECT NUMBER: 1 OF 3

FRAME RAD/LEN: 0.96

	LF	Item	A/S	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Avg Prod
1	**G**	**GRASS**	**MA**	**3200**	**2100**									**2650**
2														
3														
4														
5														
6														
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EXHIBIT PARKER: PARKER THREE-STEP

In general, the Parker Three-Step Method (Parker, 1949) was the only vegetative method approved for use in the Rocky Mountain Region for many years. It is the consensus among range professionals that methods such as cover-frequency, line intercept and rooted nested frequency provide more accurate data. Use of the Parker Three-Step Method will be phased out in the Rocky Mountain Region.

Although the data obtained from the Parker transects does not meet current needs, the transect photograph records are invaluable to demonstrate vegetative changes over time. Some of the permanent transects should be retained for this reason.

Each permanent Parker transect should be carefully evaluated to determine if it is properly located and provides a truly representative sample of the surrounding ecological type. If the transect is judged to be valuable for retention, it is suggested that the transect be reread using the Parker method first.[12] In this fashion, Parker vegetation data can eventually be correlated with ecological status and resource value ratings. In order to transition to current methods, superimpose a standard cover-frequency transect along the same 100-foot transect.

If the transect is judged to not be suitable for future condition and trend ratings, the transect should not be resampled. However, it is valuable to retake the transect photographs and maintain the permanent transect location information and photos in the permanent allotment file folder. Indicate whether the old transect location should be revisited, and at what interval.

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[12] Refer to the 1985 Range Analysis and Management Handbook, FSH 2209.21 for instructions. Data will be recorded on Form R2-2200-11.

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EXHIBIT GF: GENERAL FIELD DATA
R2-2200-GF

GENERAL DESCRIPTION

General field data are the minimum information that ties all samples, from all sources, together. It is support and supplemental data important to many different resources and uses. ***Therefore, the General Field Form will be completed for every plot, or cluster of plots, regardless of permanence, or inventory or monitoring purpose.*** The data on this form meets one or both of two criteria.

- It is generic, common data that is always collected.
- It is the minimum information that virtually ensures all plots can be later stratified for a variety of purposes.

Infrequently, only general field data may be collected on a site. This may be done as a reconnaissance (or "walk-through") plot only. Again, the stratifying characteristics come into play, as do the spatial grouping aspects.

TRAINING

Training required to complete a General Field Form is minimal. A basic understanding of natural resource inventory methods is sufficient.

PERSONNEL AND EQUIPMENT

One person can complete a General Field Form in approximately 15-20 minutes. The process will become more efficient with practice. The equipment required for completing this form includes: altimeter or quality topographic quad map with photo(s), compass, clinometer or Relaskop, 6-foot tape measure calibrated in tenths and hundredths of feet, and camera. Use of a GPS unit is strongly encouraged.

SAMPLING PROCEDURE

This form should be completed after all other inventory methods are done, especially with respect to existing and potential vegetation components, and ground cover estimates. There are certain components of this form that can be filled out while the inventory is being conducted. Experience will help the examiner determine the most efficient sequence to complete the form.

If general field data remains constant between samples, the information can be copied as such. Be careful, however, to ensure that the data is in fact the same. Some variables, such as elevation, aspect, and slope, may be slightly different. ***It is important to capture the variability in these attributes for each sample.*** Do not accelerate the information gathering process at the expense of data quality.

HEADER DATA

F1: SPATIAL IDENTIFIER (23-CHAR)

The Spatial Identifier is a combination of alphanumeric characters that uniquely identify each plot. It is a unique value across districts, forests, regions, and agencies. Spatial Identifier, in conjunction with Date (F3) and Event Type (F4) provides unique identification for every sample. Consequently data from different sources can be shared without generating confusion.

NOTE: Each and every sample — regardless of sampling method — must be assigned a unique Spatial Identifier. That value maintains the integrity of each sample in the field, as well as in the data base. A unique spatial identifier must be assigned to each sample, regardless of the number of samples within a polygon.

AGENCY (2-CHAR)

Identify the agency or unit conducting the study (Table GF-1). The spatial location of the plot will determine ownership and management responsibility. For additional codes coordinate with the Regional Office, Renewable Resources Staff.

Required *Accuracy Standard = No Errors*

REGION OR STATE (2-CHAR)

Forest Service personnel enter a 2-digit number to describe the appropriate Region (for example, Rocky Mountain Region = "02"). Other agencies may establish their own administrative unit or state designators. For example, enter the 2-character Postal Service abbreviation for the state (for example, Wyoming = "WY"). Use "UN" when the region or state is unknown.

Required *Accuracy Standard = No Errors*

NATIONAL FOREST (2-CHAR)

Enter the number for the National Forest conducting the study. (See Table GF-2 for Rocky Mountain Region codes.) Non Forest Service users may utilize their own coding conventions, for example, for BLM District, within a state game and fish agency, or for a county. Enter "XX" if there is no appropriate code.

Required *Accuracy Standard = No Errors*

RANGER DISTRICT (2-CHAR)

Enter the number corresponding to the Ranger District conducting the study (see Table GF-2). Non Forest Service users may utilize their own coding conventions in this subfield, for example, for BLM Area. The spaces for National Forest and Ranger District may be used in combination for other codes, such as county number; zero fill as necessary. Enter "XX" if there is no appropriate code.

Required *Accuracy Standard = No Errors*

Table GF-1. AGENCY CODES

CODE	DESCRIPTION
AR	Agricultural Research Station
BI	Bureau of Indian Affairs (USDI)
BL	Bureau of Land Management (USDI)
CG	County Government
FG	State Fish and Game Department
FR	Forest Service Research (USDA)
FS	Forest Service
FW	Fish and Wildlife Service (USDI)
FX	Forest Service – Stand Exam Plot (USDA)
NC	The Nature Conservancy
NP	National Park Service (USDI)
PV	Other private lands
SC	Soil Conservation Service (USDA)
SL	Department of State Lands
UR	University Research
OT	Other (explain in Comments, Form CD)

Table GF-2. FOREST AND DISTRICT CODES

02	**BIGHORN NF**
01	Buffalo RD
03	Medicine Wheel RD
04	Paintrock RD
05	Tensleep RD
06	Tongue RD
03	**BLACK HILLS NF**
01	Bearlodge RD
03	Custer RD
04	Elk Mountain RD
06	Pactola-Harney RD
08	Spearfish-Nemo RD
04	**GRAND MESA-UNCOMPAHGRE-GUNNISON NFs**
01	Collbran RD
02	Grand Junction RD
05	Norwood RD
06	Ouray RD
07	Cebolla-Taylor River RD
08	Paonia RD
06	**MEDICINE BOWROUTT NFs**
01	Yampa RD
02	Brush Creek-Hayden RD
03	Hahns Peak-Bears Ears RD
04	The Parks RD
05	Laramie RD
09	Douglas RD
07	**NEBRASKA NF**
01	Bessey RD
02	Pine Ridge RD
05	Fall River RD
06	Wall RD
09	**SAN JUAN-RIO GRANDE NFs**
01	Columbine RD
02	Dolores RD
03	Conejos Peak RD
04	Divide RD
05	Mancos RD
06	Pagosa RD
07	Saguache RD
10	**ARAPAHO-Roosevelt NFs**
01	Boulder RD
04	Estes-Poudre RD
05	Redfeather RD
06	Pawnee NG
07	Clear Creek RD
08	Sulphur RD
12	**PIKE-SAN ISABEL NFs**
01	Leadville RD
02	Salida RD
03	San Carlos RD
06	Comanche NG
07	Cimarron RD
09	Pikes Peak RD
10	South Park RD
11	South Platte RD
14	**SHOSHONE NF**
01	Clarks Fork RD
02	Greybull RD
03	Washakie RD
04	Wapiti RD
05	Wind River RD
15	**WHITE RIVER NF**
01	Aspen RD
02	Blanco RD
04	Eagle RD
07	Holy Cross RD
10	Dillon RD

QUAD IDENTIFICATION (9-CHAR)

Enter USGS code for quad sheet used in locating plot. The quad identification is the latitude and longitude of the southeast corner of the quad. This is the officially prescribed format for the Rocky Mountain Region. The number is written with latitude degrees and minutes followed by longitude degrees and minutes. For example, the Boggy Draw quad (at 37° 30' latitude and 108° 30' longitude) would be identified as: 373010830

Required *Accuracy Standard = No Errors*

SEQUENCE NUMBER (4-NUM)

Enter a sequence number that is unique by quad map up to 9999.

Required *Accuracy Standard = No Errors*

YEAR (2-NUM)

Enter the last two calendar year digits (for example, 1990 = "90").

Required *Accuracy Standard = No Errors*

An example of a complete spatial identifier follows. The 45th plot established in the Boggy Draw quad on the Pike-San Isabel NF, South Park RD during calendar year 1994, would be:

FS 02 12 10 373010830 0045 94

As described above, a new, unique spatial identifier should be assigned to each and every location. This is imperative in managing and using the information.

F2: COMPARISON SPATIAL ID (23-CHAR)

Enter the appropriate Spatial ID for a plot to be used as a comparison with this plot when doing paired plot sampling. When two plots are strategically located so as to provide an intentional comparison, the Spatial ID for the second plot would be coded in this field. Likewise, the Spatial ID for the first plot would be coded on R2-2200-GF for the second plot. For example, two plots placed on either side of a fence may be linked through this field for comparison purposes. Another example is two plots placed in close proximity to each other, where both plots represent independent samples yet describe very similar conditions. Completing this field is important during data analysis.

Required, if paired plot sampling is employed
Accuracy Standard = No Errors

F3: DATE (8-NUM)

Enter the date on which the sample data was collected. Use MMDDYYYY format.

Required *Accuracy Standard = No Errors*

F4: EVENT TYPE (5-CHAR)

Enter the event type for the data.

Required *Accuracy Standard = No Errors*

PICTURE START #: (3-NUM)

Enter the exposure number that corresponds to the first photo taken on the plot. This information, and the next, are often priceless when it comes time to sort out several rolls of pictures next winter. This field is optional and is not entered into the data base.

Optional *Accuracy Standard = No Errors*

PURPOSE (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the next (Project) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional *Accuracy Standard = No Errors*

PROJECT (25-CHAR)

This information could be used to describe the event, or for filing field forms in the proper folder. Use this field in conjunction with the previous (Purpose) to adequately describe the plot. For example, allotment and pasture names or timber sale name and prescription unit number could be used in these fields. These fields are optional and will not be entered into the data base.

Optional *Accuracy Standard = No Errors*

F5-7: EXAMINER(S) NAME

Enter last name, first name, and middle initial of individuals collecting data. List crew leader first.

Required *Accuracy Standard = No Errors*

LOCATION DATA

GPS FILE NAME (8-CHAR)

Enter the GPS file name containing the point location. If a GPS unit is not used to determine the coordinates, enter "NA".

Fields 8-48 are related to various ways of describing the plot location. Not all are required, dependent on whether GPS data is available or not. However, describing the plot location in some fashion is required.

Optional *Accuracy Standard = No Errors*

F8: QUAD IDENTIFICATION (9-CHAR)

Enter USGS code for quad sheet used in locating plot. The quad identification is composed of the latitude and longitude of the southeast corner of the quad. This is the officially prescribed format for the Rocky Mountain Region. The number is written with latitude degrees and minutes followed by longitude degrees and minutes. For example, the Boggy Draw quad (at 37° 30' latitude and 108° 30' longitude) would be identified as: 373010830

Required *Accuracy Standard = No Errors*

F9: QUAD SERIES (4-NUM)

Enter the series of the quad sheet, either "07.5" or "15.0".

Optional *Accuracy Standard = No Errors*

F10: QUAD NAME (20-CHAR)

Enter quad sheet name. Use standardized list of quad names. This is more of a reference for the examiner than anything else. A cross-reference table relating the quad identifier to the name will exist in the district production data base.

Optional *Accuracy Standard = No Errors*

STATE (2-CHAR)

Enter the two-character postal abbreviation to identify the state in which the plot is located. The five states in the Rocky Mountain Region are listed in Table GF-3.

Optional *Accuracy Standard = No Errors*

COUNTY (3-CHAR)

Enter the three-character code to identify the county in which the plot is located. The counties and their codes are listed in Table GF-3.

Optional *Accuracy Standard = No Errors*

Table GF-3. COUNTY CODES

County Number	COLORADO (CO)	KANSAS (KS)	NEBRASKA (NE)	SOUTH DAKOTA (SD)	WYOMING (WY)
1	Adams	Allen	Adams	Armstrong	Albany
3	Alamosa	Anderson	Antelope	Aurora	Big Horn
5	Arapahoe	Atchison	Arthur	Beadle	Campbell
7	Archuleta	Barber	Banner	Bennett	Carbon
9	Baca	Barton	Blaine	Bon Homme	Converse
11	Bent	Bourbon	Boone	Brookings	Crook
13	Boulder	Brown	Box Butte	Brown	Fremont
15	Chaffee	Butler	Boyd	Brule	Goshen
17	Cheyenne	Chase	Brown	Buffalo	Hot Springs
19	Clear Creek	Chautauqua	Buffalo	Butte	Johnson
21	Conejos	Cherokee	Burt	Campbell	Laramie
23	Costilla	Cheyenne	Butler	Charles Mix	Lincoln
25	Crowley	Clark	Cass	Clark	Natrona
27	Custer	Clay	Cedar	Clay	Niobrara
29	Delta	Cloud	Chase	Codington	Park
31	Denver	Coffey	Cherry	Corson	Platte
33	Dolores	Comanche	Cheyenne	Custer	Sheridan
35	Douglas	Cowley	Clay	Davison	Sublette
37	Eagle	Crawford	Colfax	Day	Sweetwater
39	Elbert	Decatur	Cuming	Deuel	Teton
41	El Paso	Dickinson	Custer	Dewey	Uinta
43	Fremont	Doniphan	Dakota	Douglas	Washakie
45	Garfield	Douglas	Dawes	Edmunds	Weston
47	Gilpin	Edwards	Dawson	Fall River	
49	Grand	Elk	Deuel	Faulk	
51	Gunnison	Ellis	Dixon	Grant	
53	Hinsdale	Ellsworth	Dodge	Gregory	
55	Huerfano	Finney	Douglas	Haakon	
57	Jackson	Ford	Dundy	Hamlin	
59	Jefferson	Franklin	Fillmore	Hand	
61	Kiowa	Geary	Franklin	Hanson	
63	Kit Carson	Gove	Frontier	Harding	
65	Lake	Graham	Furnas	Hughes	
67	La Plata	Grant	Gage	Hutchinson	
69	Larimer	Gray	Garden	Hyde	
71	Las Animas	Greeley	Garfield	Jackson	
73	Lincoln	Greenwood	Gosper	Jerauld	
75	Logan	Hamilton	Grant	Jones	
77	Mesa	Harper	Greeley	Kingsbury	
79	Mineral	Harvey	Hall	Lake	
81	Moffat	Haskell	Hamilton	Lawrence	
83	Montezuma	Hodgeman	Harlan	Lincoln	
85	Montrose	Jackson	Hayes	Lyman	
87	Morgan	Jefferson	Hitchcock	McCook	
89	Otero	Jewell	Holt	McPherson	
91	Ouray	Johnson	Hooker	Marshall	
93	Park	Kearny	Howard	Meade	
95	Phillips	Kingman	Jefferson	Mellette	
97	Pitkin	Kiowa	Johnson	Miner	
99	Prowers	Labette	Kearney	Minnehaha	

Table GF-3. COUNTY CODES (cont.)

County Number	COLORADO (CO)	KANSAS (KS)	NEBRASKA (NE)	SOUTH DAKOTA (SD)	WYOMING (WY)
101	Pueblo	Lane	Keith	Moody	
103	Rio Blanco	Leavenworth	Keya Paha	Pennington	
105	Rio Grande	Lincoln	Kimball	Perkins	
107	Routt	Linn	Knox	Potter	
109	Saguache	Logan	Lancaster	Roberts	
111	San Juan	Lyon	Lincoln	Sanborn	
113	San Miguel	McPherson	Logan	Shannon	
115	Sedgwick	Marion	Loup	Spink	
117	Summit	Marshall	McPherson	Stanley	
119	Teller	Meade	Madison	Sully	
121	Washington	Miami	Merrick	Todd	
123	Weld	Mitchell	Morrill	Tripp	
125	Yuma	Montgomery	Nance	Turner	
127		Morris	Nemaha	Union	
129		Morton	Nuckolls	Walworth	
131		Nemaha	Otoe		
133		Neosho	Pawnee	Washington	
135		Ness	Perkins	Yankton	
137		Norton	Phelps	Ziebach	
139		Osage	Pierce		
141		Osborne	Platte		
143		Ottawa	Polk		
145		Pawnee	Red Willow		
147		Phillips	Richardson		
149		Pottawatomie	Rock		
151		Pratt	Saline		
153		Rawlins	Sarpy		
155		Reno	Saunders		
157		Republic	Scotts Bluff		
159		Rice	Seward		
161		Riley	Sheridan		
163		Rooks	Sherman		
165		Rush	Sioux		
167		Russell	Stanton		
169		Saline	Thayer		
171		Scott	Thomas		
173		Sedgwick	Thurston		
175		Seward	Valley		
177		Shawnee	Washington		
179		Sheridan	Wayne		
181		Sherman	Webster		
183		Smith	Wheeler		
185		Stafford	York		
187		Stanton			
189		Stevens			
191		Sumner			
193		Thomas			
195		Trego			
197		Wabaunsee			
199		Wallace			
201		Washington			
203		Wichita			
205		Wilson			
207		Woodson			
209		Wyandotte			

AERIAL PHOTO IDENTIFICATION

These fields identify the aerial photo on which the plot can be identified. Most of the information is on the photo.

F11: DATE (10-CHAR)

Enter the date (MM/DD/YYYY) the aerial photo used to locate this plot was taken.

Optional ***Accuracy Standard = No Errors***

F12: SOURCE (5-CHAR)

Record the code that identifies the agency administering the photo acquisition project. For example, "USFS" identifies the U.S. Forest Service.

Optional ***Accuracy Standard = No Errors***

F13: SCALE (5-CHAR)

Record the nominal scale of the photos for that flight. For example, "1:24,000" identifies a scale of 1 to 24,000.

Optional ***Accuracy Standard = No Errors***

F14: PROJECT/CODE (6-CHAR)

Record the symbol or code for the mission, flight, or project when the photos were taken. For example, "612130".

Optional ***Accuracy Standard = No Errors***

F15: FLIGHT LINE (3-CHAR)

Record the code that indicates the photo flight line.

Optional ***Accuracy Standard = No Errors***

F16: ROLL NUMBER (3-CHAR)

Record the code that identifies the roll and contract fiscal year. For example, "189" identifies roll 1 taken in fiscal year 1989.

Optional ***Accuracy Standard = No Errors***

F17: EXPOSURE NUMBER (3-CHAR)

Record the number that identifies the exposure or print.

Optional ***Accuracy Standard = No Errors***

Traditionally plot locations have been to the nearest quarter-quarter section with a pin-pricked photo or ink dot on a map to specify the exact location. With the advent of GPS and GIS technologies two other avenues of specifying a plot location are becoming increasingly more common. The required minimum is that one or the other must be provided, while the traditional legal location is just an option. Identifying the plot location by either latitude/longitude or UTM coordinates is the required approach.

F18-20: LATITUDE (2-NUM, 2-NUM, 4-NUM)

Enter the degrees, minutes, seconds, and hundredths of a second for the latitude coordinate of the plot. It is assumed that the latitude is north of the equator. An example entry is:

N 45° 16' 12.25"

Required, if UTM coordinates are not recorded
Accuracy Standard = ± 15 seconds

F21-23: LONGITUDE (3-NUM, 2-NUM, 4-NUM)

Enter the degrees, minutes, seconds, and hundredths of a second for the longitude coordinate of the plot. It is assumed that the longitude is west of the Greenwich Prime Meridian. An example entry is:

W 106° 26' 22.55"

Required, if UTM coordinates are not recorded
Accuracy Standard = ± 15 seconds

F24-F27: UTM (8-NUM, 8-NUM, 5-NUM, 2-NUM)

Enter the Universal Transverse Mercator Grid Codes for the coordinates of the plot. Enter the north UTM coordinate (8-num), the east UTM coordinate (8-num), and the UTM elevation (5-num) for the plot location. Enter the last two digits of the year (2-num) of the UTM projection used to locate the plot. Most quads have 1927 UTM projection, but some revised quads will have a newer 1983 projection. The 1983 projection is different from the 1927 projection. In order to cross-reference location, projection dates are Required

Required, if latitude/longitude coordinates are not recorded *Accuracy Standard = ± 100 meters*

F28-F33: LEGAL ID (5-CHAR, 5-CHAR, 2-NUM, 2-CHAR, 2- CHAR, 2-NUM)

Describe the legal location of the plot. Enter the township and range, including the cardinal indicator (5-char, each). Space has been provided for half-townships or half-ranges — do not complete these if they are not needed. Enter the section number (2-num). Enter the quarter section (2-char) and quarter-quarter section (2-char) as necessary; use NE, SE, SW, or NW. Identify the principal meridian code (2-num).

Optional *Accuracy Standard = No Errors*

WATERSHED HIERARCHY

These fields identify the watershed where the plot is located. The codes are hierarchical in that they describe coarse (5th level) to detailed (9th level) watershed delineations. Consult the Forest hydrologist or fisheries biologist for a listing of codes to be used in the survey area.

All Are Optional *Accuracy Standard = No Errors*

F34: 5TH LEVEL (10-NUM)

Enter the appropriate 5th level watershed code.

F35: 6TH LEVEL (2-NUM)

Enter the appropriate 6th level watershed code.

F36: 7TH LEVEL (2-NUM)

Enter the appropriate 7th level watershed code.

F37: 8TH LEVEL (2-NUM)

Enter the appropriate 8th level watershed code.

F38: 9TH LEVEL (2-NUM)

Enter the appropriate 9th level watershed code.

SAMPLE SYSTEM DATA

This information (fields 39-42) describes the sample system used. It includes plot dimension information.

F39: PLOT RADIUS OR LENGTH (3-NUM)

This describes the plot size used to complete the General Field Data Form (R2-2200-GF). Enter the plot radius (for circular plots) or length (for rectangular plots) to the nearest unit. Plot dimensions for ocular plant composition, cover-frequency, and line intercept plots are recorded on the respective forms for those methods.

Required *Accuracy Standard = ± 1 foot*

F40: PLOT WIDTH (3-NUM)

If a rectangular plot is used for the describing the General Field Data, then enter the width of the plot to the nearest foot in this field. If a circular plot shape is used, enter "000" (numeric). This describes the plot size used in completing the General Field Data Form (R2-2200-GF). Plot dimensions for ocular plant composition, cover-frequency, and line intercept plots are recorded on the respective forms for those methods.

Required *Accuracy Standard = ± 1 foot*

F41: UNIT OF MEASUREMENT (2-CHAR)

Enter the unit of measure for the plot dimensions. For example, FT = feet and M = meters.

Required *Accuracy Standard = No Errors*

F42: REMEASUREMENT INTERVAL (2-NUM)

For permanent plots, enter the number of years to the next measurement. For example, "00" indicates that the plot is not a permanent plot; "01" means remeasure annually; "02" means remeasure 2 years from now; "15" means it will be measured 15 years from now, and "-1" means the interval is unknown.

Required, for permanent plots
Accuracy Standard = No Errors

SITE DATA

This information (fields 43-67) describes certain environmental, topographic, and biotic attributes. These pieces of information are important for evaluating data for any purpose.

F43: ELEVATION (5-NUM)

Enter the elevation of the plot above mean sea level (MSL) in feet. Use an altimeter — be sure to reset the altimeter at a point of known elevation every morning and afternoon. A topographic map may be used to estimate elevation, however be sure to use aerial photos to accurately locate the plot position before making an estimation.

Required ***Accuracy Standard = ± 100 ft***

F44: UNIT OF MEASURE (2-CHAR)

Enter the unit of measure for elevation. For example, FT = feet and M = meters.

Required ***Accuracy Standard = No Errors***

F45: COMPASS DECLINATION (5-CHAR)

Enter the declination setting for your compass. Do not enter the declination from the map. This field is necessary to accurately analyze data collected from non-declinated, declinated, and incorrectly declinated compasses. For example:

3.5E

Required ***Accuracy Standard = ± 1 degree***

F46: ASPECT (3-NUM)

Enter the declination-corrected azimuth of the slope aspect to the nearest degree. Enter flat areas as "0" and North as "360".

Required ***Accuracy Standard = ± 5 degrees***

F47: SLOPE PERCENT (3-NUM)

Enter the average percent slope of the terrain on which the sample plot is located.

Required ***Accuracy Standard = ± 5 percent***

F48: UNIT OF MEASURE (2-CHAR)

Enter the unit of measure for slope. For example, PC = percent and DE = degrees.

Required ***Accuracy Standard = No Errors***

F49: SPECIAL FEATURE (2-CHAR)

If the dominant environment of the plot is one of the following special features (see Table GF-4), enter the appropriate code. In many cases, there is no special feature; enter an "NA" in this case. The codes are hierarchical in design, consequently you may choose from the more generic codes (for example, "AC", "NS", or "SE") or from the more detailed codes (for example, "AN", "SW", or "BE"). *(The first column is a rough grouping to assist the examiner in finding the correct code — it is not to be coded on the field form!)*

Required ***Accuracy Standard = Good Judgment***
Coordinate with Regional Office for additional codes

Table GF-4. SPECIAL FEATURE CODES

	CODE	DESCRIPTION
	NA	Not applicable
rocky	AC	Avalanche chute
	AN	With non-scoured surface (soil not being eroded)
	AS	With scoured surface (soil eroded, rocks exposed)
	CR	Scree (sheet of stones or rocky debris mantling a slope)
	TA	Talus (rock fragments derived from and positioned at the base of a cliff)
cave	CV	Cave
crop	CL	Cropland
	CD	Dryland crops
	CI	Irrigated crops
moist	SC	Streamside community
	SB	Stream bar community
	NS	Non-stream riparian communities
	SW	Shrub wetland (for example, willows and birches)
	WM	Wet meadow dominated by graminoids (for example, sedges and grasses)
	PE	Peatland (for example fen, bog, and carr)
	FL	Floating or quaking bog or fen mat
	LA	Lakeside communities
seep	SA	Swale (concave or bench area with no surface water, but moist surface soil produces vegetation reflecting a moist environment)
	SE	Seep and/or spring
	BE	Concave bench with surface water creating moist or wet soil that supports vegetation reflecting a moist site
	SS	Side slope seep (not on bench or concavity)
terrace	TE	Terrace (in valley bottom)
affects micro-climate	SN	Snow catchment area (retains snow cover 2-4 weeks longer than 90% of the surrounding areas of same aspect due to deeper snow accumulation on a different physiographic location, includes nivational hollows)
	CA	Cold air drainage and frost pocket
	WB	Wind blasted environments where vegetation is maintained in a deformed state
	UW	Upslope warm air flow; area that is in the direct path of afternoon warm air upslope flow from an adjacent deep valley bottom or a thermal belt above a cold air inversion area
	WU	Windswept upper slopes that do not accumulate snow and are relatively dry due to snow loss in comparison to adjacent areas
ribbon forest	RI	Ribbon forest
	RR	Ridge top ribbon forest
	RS	Snow-caused ribbon forest
	RG	Geologically-caused ribbon forest
	O	Other (explain on Form CD, comments data)
	X	Unable to assess

PLOT RELIEF (SHAPE)

The micro-site shape of a plot, whether it is 0.01, 0.10, or 0.20 acres in size, often influences the relationship between environmental, topographic, and vegetative features. The next two fields (50-51) describe the plot shape along two axes. These axes are referenced as vertical and horizontal.

The vertical axis lays perpendicular to the contours; it goes from up-slope to down-slope, regardless of the slope angle. The horizontal axis is oriented across the slope, or with the contour; it goes from side-slope to side-slope. Use the standard NRCS codes and definitions (Table GF-5) to describe both vertical and horizontal plot shapes.

F50: SLOPE SHAPE VERTICAL (2-CHAR)

Enter one of the above codes that best describes the vertical shape of the micro-site where the plot is located. It is generally confined to the dimensions of a 0.10 to 0.20 acre plot.

Required ***Accuracy Standard = No Errors***

F51: SLOPE SHAPE HORIZONTAL (2-CHAR)

Enter one of the above codes that best describes the horizontal shape of the micro-site where the plot is located. It is generally confined to the dimensions of a 0.10 to 0.20 acre plot.

Required ***Accuracy Standard = No Errors***

Table GF-5. RELIEF TYPES

CODE	DESCRIPTION
CV	Concave (also depression)
CX	Convex (also raised)
B	Broken: cliffs, knobs, and/or benches interspersed with steeper slopes; generally characterized by sharp, irregular breaks
L	Linear/planar (also straight, even, smooth)
P	Patterned: relief of hummocks and swales within several feet
U	Undulating (also rolling): pattern of one or more low relief ridges or knolls and draws
X	Unable to assess

F52-54: SURFICIAL GEOLOGY (2-CHAR, 2-CHAR, 3-CHAR)

Describe the parent material (surficial geology), that is, the source of soil development. Limit observation to the plot, that is, identify the parent material as if a soil pit was dug in the middle of the plot. Parent material can be identified from road cuts, stream channel cuts, or a quick scratch hole. Often, the common land unit (CLU) or soil resource inventory (SRI) identifies the parent material. When using SRI or CLU information, be sure the description matches the site.

The first field is required and the second field is strongly recommended. The first is the broad geologic group (primary lithology), such as igneous, sedimentary, or metamorphic (Table GF-6).

The second group is group member (secondary lithology), that is, the specific lithologic unit (Table GF-7). The lithologic unit is a system of rock classification based on manner of origin, composition, and texture. It is identified from USGS geologic maps and verified on the ground. Nomenclature examples of coding for lithologic unit are limestone (Ls-consolidated material) or loess (Uw-unconsolidated material).

The third code is the 2- or 3-character code from the USGS geology map. It corresponds to the geologic formation for the site, a mappable body of rock identified by distinct characteristics, some degree of internal homogeneity, and stratiographic position. It identifies both primary and secondary lithology. Examples of the nomenclature and coding for geologic formations are Mancos Shale Formation (Km) or Morrison Formation (Jm).

Required ***Accuracy Standard = No Errors***

Table GF-6. PRIMARY LITHOLOGY

CODE	PRIMARY LITHOLOGY
I	Igneous Intrusive
V	Igneous Extrusive
S	Sedimentary
M	Metamorphic
U	Unconsolidated
X	Mixed

Table GF-7. SECONDARY LITHOLOGY

Primary Lithology	Secondary Lithology	CODE
IGNEOUS INTRUSIVE	Diorite	DI
	Gabbro	GA
	Gabbro/Diorite	GD
	Granite	GR
	Granodiorite	GN
	Monzonite	MO
	Pegmatite	PG
	Peridotite	PD
	Syenite	SY
	Syenodiorite	SD
IGNEOUS EXTRUSIVE	Andesite	AN
	Basalt	BS
	Basaltic-Andesite	BA
	Dacite	DA
	Latite	LA
	Obsidian	OB
	Pumice	PU
	Rhyolite	RH
	Tephra	TE
	Trachyte	TR
	Tuff	TF
	Volcaniclastic	VC
SEDIMENTARY	Anhydrite	AH
	Arkose	AR
	Asphalt	AS
	Breccia	BR
	Chert	CH
	Coal, Anthracite	CA
	Coal, Bituminous	CB
	Conglomerate	CG
	Diatomite	DT
	Dolomite	DO
	Graywacke	GW
	Gypsum	GY
	Halite	HA
	Hematite	HE
	Interbedded Sandstone and Siltstone	IS
	Interbedded Sandstone and Shale	IH
	Lignite	LG
	Limestone	LS
	Limonite	LI
	Peat	PE
	Phosphorite	PH
	Sandstone	SS
	Shale	SH
	Siltstone	SI
	Travertine	TV
	Tufa	TU
METAMORPHIC	Amphibolite	AM
	Argillite	AR
	Crystalline Metamorphic	MX
	Gneiss	GN
	Hornfels	HO
	Marble	MA
	Metaquartzite	MQ
	Metasedimentary Melange	MM
	Metasedimentary	MS
	Metavolvanic	MV
	Mylonite	MY
	Phyllite	PL
	Schist	SC
	Serpentine	SP
	Serpentine Melange	SM
	Slate	SL
	Soapstone	SO
	Quartzite	QT
UNCONSOLIDATED	Alluvium[1]	AL
	Colluvium	CO
	Dune Sand	DS
	Eolian	EO
	Glacial	GL
	Glacial Moraine	GM
	Glacial Outwash	GO
	Glacial Till	GT
	Human Caused/ Constructed	HC
	Lakebed or Lacustrine	LC
	Loess	LO
	Marine	MR
	Organic	OR
	Transitional	TL

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[1] Sandy, clayey, gravelley, and silty will be covered under parent material-surficial deposit textural modifier.

F55: EROSION STATUS (2-CHAR)

Enter the most appropriate code (Table GF-8) describing soil erosion status based on indicators such as soil cover, sheet erosion, rill erosion, bank stability, and gullying. Instability includes situations where human activity has increased the rates of disturbance above that which would occur naturally.

Required ***Accuracy Standard = Good Judgment***

F56: EROSION TYPE (2-CHAR)

Enter the most appropriate code (Table GF-9) to describe the dominant erosion process present on the plot.

Required ***Accuracy Standard = Good Judgment***

Table GF-8. EROSION STATUS TYPES

CODE	DESCRIPTION
ST	Soil surface stable and no evidence of accelerated erosion
X	Unable to assess because examiner cannot determine stability or instability compared to undisturbed conditions
UC	Soil surface is unstable because of compaction (weight per unit volume is greater than natural)
UD	Soil surface is unstable because of displacement and/or churning of the soil
UE	Soil surface is unstable due to evidence of accelerated erosion

Table GF-9. EROSION TYPES

CODE	DESCRIPTION
NA	Not applicable
SE	Sheet erosion
RE	Rill erosion
GE	Gully erosion
DE	Deposition
WE	Wind erosion
SC	Soil creep
SL	Slump
TD	Terrace development
SD	Slide
SP	Splash erosion/soil crust
OT	Other (explain on Form CD)
XX	Unable to assess

HORIZON SLOPES

Enter the percent slope to horizon from plot center. Negative slopes are entered as zero. These values are used in models to predict, or index, the maximum amount of solar radiation a site may receive. This information is important in describing and interpreting evapo-transpiration and solar energy flux characteristics of the site. These attributes can be quickly collected by taking three additional readings with a clinometer or Relaskop at the same time as slope.

NOTE: Horizon is calculated as the percent slope between the plot center and the first landform feature encountered (for example, hill top or ridge line). Vegetation obstruction is ignored in this calculation.

F57: HORIZON TO THE EAST (3-NUM)

Enter the percent slope of the vertical angle between the plot center and the horizon to the east of plot center.

Optional ***Accuracy Standard = ± 5 percent slope***

F58: HORIZON TO THE SOUTH (3-NUM)

Enter the percent slope of the vertical angle between the plot center and the horizon to the south of plot center.

Optional ***Accuracy Standard = ± 5 percent slope***

F59: HORIZON TO THE WEST (3-NUM)

Enter the percent slope of the vertical angle between the plot center and the horizon to the west of plot center.

Optional ***Accuracy Standard = ± 5 percent slope***

GROUND COVER

Enter percent ground cover at the soil surface plane for each category listed. The percent ground cover can be obtained from an inventory sample, for example ocular plant composition plot or cover-frequency transect. If the ground cover estimates are obtained in this fashion, then enter the percent ground cover value directly from that form. If no inventory sample has been done, then estimate the percent ground cover for each category. Ocularly estimate the percent ground cover (***preferred***), or use cover classes (Table GF-10 or Table GF-11) and enter the appropriate midpoint value.

The purpose of collecting ground cover data is to describe the ground surface. Interpretations regarding soil surface protection, erosion probability, organic matter contribution, and effects of use such as recreation, grazing, and mechanical activity will be made from this data.

Therefore, the question of whether moss covering a rock should be recorded as "moss" or "rock" is evaluated against the data objective. The result is to record cover as stone, boulder, etc. — whichever describes the soil surface and is what affects the above interpretations. In addition, moss that is growing directly on the soil surface should be recorded as "moss".

As a vegetative entity, the cover of moss should be captured by recording a bryophyte ("B") life form, "MOSS" species, and the appropriate percent cover. Do not record any moss cover more than once.

The total ground cover for all categories will sum to 100 percent. Given the range of variability in examiners and the difficulty of summing midpoints, the actual total should be between 90-110 percent when using cover classes. (Foliar canopy cover above the soil surface plane is not considered to be ground cover.)

Table GF-10. COVER CLASSES ('DAUBENMIRE')

CODE	RANGE	MIDPOINT
T	0 - 1.0%	0.5%
1	1.1 - 5.0%	3.0%
2	5.1 - 25.0%	15.0%
3	25.1 - 50.0%	37.5%
4	50.1 - 75.0%	62.5%
5	75.1 - 95.0%	85.0%
6	95.1 - 100.0%	97.5%

Table GF-11. COVER CLASSES ('10-CLASSES')

CODE	RANGE	MIDPOINT
T	0 - 1.0%	0.5%
0	1.1 - 5.0%	3.0%
1	5.1 - 15.0%	10.0%
2	15.1 - 25.0%	20.0%
3	25.1 - 35.0%	30.0%
4	35.1 - 45.0%	40.0%
5	45.1 - 55.0%	50.0%
6	55.1 - 65.0%	60.0%
7	65.1 - 75.0%	70.0%
8	75.1 - 85.0%	80.0%
9	85.1 - 95.0%	90.0%
A	95.1 - 99.0%	97.0%
X	99.1 - 25.0%	99.5%

F60: WOOD

Charred and uncharred dead wood greater than 0.25 inches (6 mm) in diameter.

Required *Accuracy Standard = ±1 class*

F61: LITTER/DUFF/ASH

Litter is material less than 0.25 inches (6 mm) in diameter — freshly fallen leaves, needles, twigs, fecal material, bark, and fruits. Duff is fermentation and humus sections of the organic layer. Ash is charred litter, duff, and scat.

Required *Accuracy Standard = ±1 class*

F62: DUFF & LITTER DEPTH (3-NUM)

Determine the average depth of the duff-plus-litter layer on the plot to the nearest 0.10 inch. Duff is the fermentation and humus sections of the organic layer. Litter includes freshly cast organic material (for example, leaves, needles, twigs, bark, and fruits).

Optional *Accuracy Standard = ± .5 in*

F63: MOSS/LICHEN/ FUNGUS/ALGA

Moss, lichen, fungus, and alga directly on the soil surface. *Do not include moss or lichen on rock, wood, or other surface*. These values characterize the soil surface. Examiners are encouraged to record these items on the ocular plant composition plot or cover-frequency transect and to assign a percent canopy cover for each. Other studies outside rangeland inventory and analysis, in particular air quality studies, deal with these life forms at the species level.

Required *Accuracy Standard = ±1 class*

F64: BASAL VEGETATION

The soil surface occupied by live basal or root crown portion of **vascular** plants. This includes live trees, *Lycopodium*, and *Selaginella*. This is not the **foliar** cover of plants. Typical **basal** plant cover ranges between 3-7 percent; 15 percent is very high and is rarely encountered.

Required *Accuracy Standard = ±1 class*

F65: WATER

That portion of the plot area that is covered by standing water at the time of the sampling.

Required *Accuracy Standard = ±1 class*

F66: BARE SOIL

Exposed mineral soil (bare ground) with particle size of less than 0.0625 inches (2 mm) diameter soil particles.

Required *Accuracy Standard = ±1 class*

F67: GRAVEL

Exposed mineral material with particle size between 0.0625-3.0 inches (2-78 mm) in diameter.

Required *Accuracy Standard = ±1 class*

F68: COBBLE

Exposed mineral material with particle size between 3.0-10.0 inches (78-254 mm) in diameter.

Required *Accuracy Standard = ±1 class*

F69: STONE

Exposed mineral material with particle size between 10.0-24.0 inches (254-610 mm) in diameter.

Required *Accuracy Standard = ±1 class*

F70: BOULDER

Exposed mineral material with particle size greater than 24.0 inches (610 mm) in diameter.

Required *Accuracy Standard = ±1 class*

F71: BEDROCK

Exposed bedrock material.

Required *Accuracy Standard = ±1 class*

F72: FUEL MODEL (2-NUM)

Fuel loading classes are from fire behavior fuel models of Anderson (1982) and Albini (1976). Enter the appropriate code (Table GF-12).

Classes are general and describe the fuels that will drive the fire behavior models. The list has been subdivided into broad groupings to assist the examiner in identifying the correct fuel model. (It is not to be coded on the field form!)

If you are not familiar with this system be sure to reference Anderson (1982) and obtain assistance from a qualified fire behavior specialist. If you do not have the publication or have not been trained to identify fuel loading classes, enter "00" in this field.

Optional *Accuracy Standard = Good Judgment*

Table GF-12. FUEL MODELS

	CODE	DESCRIPTION
	00	Unable to assess.
herb	01	Fine, porous and continuous herbaceous fuels of grasslands, savannas, grass-tundra, and grass-shrub types.
	02	Fine herbaceous fuels with some litter and dead stemwood in habitat types with open shrub and forest overstories.
	03	Tall, thick graminoid-dominated stands.
shrub or woodland	04	Forest or shrub stands with a continuous overstory that contains much flammable wood material.
	05	Forest or shrub stands with light surface fuels and slightly flammable shrub and woody fuels.
	06	Open forest with shrubs or shrubs that have moderate amounts of flammable woody material.
forest	07	Closed forest stands and understory shrub layer with flammable materials in both layers.
	08	Closed conifer stands with low flammability and a compact litter layer.
	09	Closed stands of ponderosa pine with a thick litter layer.
	10	Closed forest types with heavy fuel loading of down woody material.
slash	11	Light logging slash, varying in continuity.
	12	Moderate, continuous logging slash.
	13	Heavy, continuous logging slash.

F73: AVERAGE FUEL DEPTH (3-NUM)

Determine the average depths of all live and dead ground fuels on the plot to the nearest 0.1 foot. Fuel depth is the vertical distance from the bottom of the litter layer to the highest fuel particle (less than 6.5 feet tall) that is capable of carrying a ground fire under moderate fuel moisture and wind conditions.

This value is averaged over the plot (for example, envision a sheet draped over the ground fuels and live and dead shrub/herb layer on the plot and determine the average height of that sheet). This calculation does not include the crowns of overstory trees or any species greater than 6.5 feet tall.

Optional *Accuracy Standard = ± .5 feet*

F74: UNIT OF MEASUREMENT (2-CHAR)

Enter the unit of measure for fuel depth measurement. For example, IN = inches, FT = feet, and M = meters.

Required *Accuracy Standard = No Errors*

F75: DOWN LOG AVERAGE DIAMETER (3-NUM)

Enter an estimate of the average diameter of the down wood material. Entries are to the nearest inch.

Optional *Accuracy Standard = ± 1 in*

F76: UNIT OF MEASUREMENT (2-CHAR)

Enter the unit of measure for log diameter measurement. For example, IN = inches and CM = centimeters.

Required *Accuracy Standard = No Errors*

F77: NUMBER WOODY PIECES (3-NUM)

Enter an estimate of woody pieces greater than 3" in diameter at the small end. Entries are to the nearest inch.

Optional
Accuracy Standard = ± 10 percent of total

MAJOR DISTURBANCES

F78-89

Describe major disturbance events. Each disturbance must be described by type, date (estimated as accurately as possible), intensity, and estimated periodicity of the disturbance type prior to the last occurrence.

DISTURBANCE TYPE (4-CHAR)

Enter the following code to describe the disturbance type. Types are identified by a broad category and then subdivided by more specific event descriptions (Table GF-14). Identifying the broad category is Required Identifying the more specific type is optional, but should be done if the specific type can be identified.

Required ***Accuracy Standard = Good Judgment***

DATE OF DISTURBANCE (8-NUM)

Estimate the decade, year, month, or date of the most recent occurrence of each disturbance type identified. The time frame specified will depend on the time scale involved with that particular disturbance. Wildfires may be dated to the nearest year, or sometimes nearest decade, depending on how far back the most recent disturbance occurred. Frost damage or sunscald, however, can often be pinpointed to a week, or even a day, based on weather records. Use MM-DD-YYYY format.

Optional ***Accuracy Standard = Good Judgment***

DISTURBANCE INTENSITY (1-CHAR)

Describe the intensity of the disturbance in broad general terms (Table GF-13). The examiner will normally be familiar with the range of intensities that can occur for any given disturbance type. Grossly estimate the intensity of the most recent disturbance occurrence, using the following codes.

Optional ***Accuracy Standard = Good Judgment***

DISTURBANCE PERIODICITY (4-NUM, 1-CHAR)

Estimate the return interval for the disturbance identified. This estimate should normally be for the period prior to the last occurrence of the type. This is particularly true for wildfire, where the periodicity may be significantly different before European settlement.

The estimate should be reasonable, given the time perspective involved. Decades for wildfire or insect infestations are normal, whereas years for some timber harvest activities or months for grazing systems may be more appropriate. Enter the appropriate numeric value, followed by a "D" (day), "M" (month), or "Y" (year) to indicate the time scale.

Optional ***Accuracy Standard = Good Judgment***

Table GF-13. EVENT INTENSITIES

CODE	DESCRIPTION
H	highly disturbed
M	moderately disturbed
S	slightly disturbed
N	no disturbance for 75-100 years
X	unable to assess

Table GF-14. DISTURBANCE TYPES

BROAD CATEGORY	SPECIFIC TYPE	DESCRIPTION
BU		BURN SCENARIOS (FIRE)
	BB	broadcast slash burn — planned ignition
	WS	wildfire in slash
	JB	jackpot burn
	DP	dozer pile and burn
	UB	understory burn
	WN	wildfire — natural fuels
	PI	prescribed burn — planned ignition in natural fuels
	UI	prescribed burn — unplanned ignition in natural fuels
	OB	other burning
DI		**DISEASE ATTACKS**
	BR	butt rot
	BL	blister rust
	GR	gall rust
	HR	heart rot
	NC	needle cast
	RR	root rot
	OD	other disease
GR		**GRAZING SYSTEMS**
	SL	season long grazing system
	DR	deferred rotation grazing system
	RR	rest rotation grazing system
	DG	deferred grazing system
	HM	holistic management grazing system
	OC	other cattle grazing system
	OS	other domestic sheep grazing system
HM		**HARVEST METHODS**
	CC	clearcut
	FW	firewood harvest
	GS	group selection cut
	HE	heavy equipment disturbance not associated with one of the coded activities
	IS	individual selection cut
	OR	overstory removal
	PP	post and pole harvest
	SK	skid trail
	SN	sanitation cut
	ST	seed tree
	SV	salvage cut
	SW	shelterwood
	OH	other timber harvest
IN		**INSECT INFESTATIONS**
	AP	aphids
	MP	mountain pine beetle
	SP	spruce budworm
	WE	weevil
	OI	other insect infestation
MI		**MINING ACTIVITIES**
	TI	tailing impoundment
	WD	waste dump
	OP	open pit or cut
	RR	reclamation by recontouring
	RF	reclamation be fertilization
	RS	reclamation be seeding
	TA	reclamation be topsoil application
	GS	reclamation be ground surface scarification
	OM	other mining activity
RE		**RECREATION ACTIVITIES**
	FI	fishing
	HI	hiking trails
	CA	camping
	PI	picnicing
	OR	other recreation activity
RG		**REGENERATION ACTIVITIES**
	BR	bareroot planting
	CS	containerized stock planting
	FA	fertilizer application
	FE	fencing
	GS	grass seeding
	HA	herbicide application
	PA	pesticide application
	PB	poison baiting
	SC	scarification
	SH	shade cards
	SP	scalping
	OG	other regeneration activity
TS		**TIMBER STAND IMPROVEMENTS**
	CT	commercial thinning
	PC	precommercial thinning
	PR	pruning
	WS	weed species removal
WC		**WEATHER CONDITIONS**
	BD	blow down
	DR	drought damage
	FD	frost damage
	FL	flood damage
	IC	ice
	SC	soil creep
	SN	snow
	SS	sun scald
	WD	winter desiccation
WL		**WILDLIFE ACTIVITIES**
	AR	antler rubs
	BR	browsing
	BU	burrows
	DN	denning
	NE	nesting
	RO	rodents
	AN	antelope
	BB	black bear
	BE	bear (species unknown)
	BS	bighorn sheep
	BV	beaver
	CA	cattle
	CO	coyote
	DE	deer
	DO	dog
	DS	domestic sheep
	EL	elk
	GB	grizzly bear
	GS	ground squirrel
	HO	horse
	MG	mountain goat
	ML	mountain lion
	MO	moose
	PD	prairie dog
	PG	pocket gopher
	PM	pine marten
	PQ	porcupine
	PW	pileated woodpecker
	RA	rabbit
	RT	raptor
	TS	tree squirrel
	UB	upland birds
	WO	wolf
	OW	other wildlife activity
NA		**NOT APPLICABLE**
OT		**OTHER EVENT TYPE**

F90-95: ANIMAL USE EVIDENCE (SIX 2-CHAR)

Enter one or more codes to describe animal use evidence (Table GF-15) in decreasing order of use and effect on vegetation and site characteristics. Evidence may include tracks, browse, caches, beds, wallows, scat, antler rubs, nests or dens, or others.

Consult the Regional Office for additional codes
Required ***Accuracy Standard = Good Judgment***

Table GF-15. ANIMAL USE EVIDENCE TYPES

CODE	DESCRIPTION
NO	No evidence found
AN	Antelope
BB	Black bear
BE	Bear (species unknown)
BS	Bighorn sheep
BV	Beaver
CA	Cattle
CO	Coyote
DE	Deer
DO	Dog
DS	Domestic Sheep
EL	Elk
GB	Grizzly bear
GS	Ground squirrel
HO	Horse
HU	Human
MG	Mountain goat
ML	Mountain lion
MO	Moose
PD	Prairie dog
PG	Pocket gopher
PM	Pine marten
PQ	Porcupine
PW	Pileated woodpecker
RA	Rabbit
RT	Raptor
TS	Tree squirrel
UB	Upland birds
WO	Wolf
OT	Other (explain on Form CD)
X	Unable to assess

EXISTING VEGETATION

The data in this grouping provides information on the existing vegetation, that is the vegetation currently occupying a site. *All fields are required.*

This data grouping represents the best example of information that can be used to stratify a large data set for virtually any purpose, including forest plan revision, area analysis, project planning, biodiversity assessment, and ecological type classification. These fields describe the physical distribution of the vegetation by life form and size class, without regard to individual species. They cannot necessarily be used for photo interpretation.

The absence of this information significantly weakens the utility of the sample outside the sole purpose for which it was established. Therefore these fields are required.

Estimate the percent canopy cover for the following life forms and age/size classes within the shrub and tree life forms. *These fields are required.* The estimate is the horizontal percent cover of the vertical projection of the particular life form. Ocularly estimate (***preferred***) the percent canopy cover, or use the cover classes below and enter the appropriate midpoint value.

F96: COVER TYPE (4-CHAR)

Identify and record cover type as defined by either the Society of Range Management or the Society of American Foresters. A listing of cover types and codes is in Table GF-16.

Optional ***Accuracy Standard = Good Judgment***

TREE COVER

Estimate percent canopy cover for trees by size class. Size classes correspond to the RMRIS data base. *These fields are required.* This estimate is the percent cover of the vertical projection of trees; do not account for overlap. Do not include trees less than 6 inches tall.

Percent canopy cover can be obtained from an inventory sample, for example ocular plant composition plot. If canopy cover estimates are obtained in this fashion, then derive percent canopy cover value from that form. If no inventory sample has been done, then estimate the percent canopy cover for each size class.

All Are Required
Accuracy Standard = ±10 percent

F97: TOTAL TREE COVER (3-NUM)

Total tree cover (do not overlap).

F98: SEEDLING (3-NUM)

Seedling size cover (≥ 6 inches tall and < 0.1 inch DBH).

F99: SAPLING (3-NUM)

Sapling size cover (0.1 - 4.9 inch DBH).

F100: POLE (3-NUM)

Pole size cover (5.0 - 8.9 inch DBH).

F101: MEDIUM (3-NUM)

Medium size cover (9.0 - 15.9 inch DBH).

F102: LARGE (3-NUM)

Large size cover (16.0 - 32.9 inch DBH).

F103: VERY LARGE (3-NUM)

Very large size cover (≥ 33.0 inch DBH)

SHRUB COVER

Estimate percent canopy cover for shrubs by size class. *These fields are required.* This estimate is the horizontal percent cover of the vertical projection of shrubs; do not account for overlap.

The percent canopy cover can be obtained from an inventory sample, for example ocular plant composition plot, cover-frequency transect, or line intercept. If the canopy cover estimates are obtained in this fashion, then derive the percent canopy cover value from the appropriate form. If no inventory sample has been done, then estimate the percent canopy cover for each size class.

F104: TOTAL SHRUB COVER (3-NUM)

Total shrub cover.

F105: LOW (3-NUM)

Low size shrub cover (< 2.5 feet tall).

F106: MIDDLE (3-NUM)

Middle size shrub cover (2.5 - 6.5 feet tall).

F107: TALL (3-NUM)

Tall size shrub cover (> 6.5 feet tall).

HERBACEOUS COVER

Estimate percent canopy cover for each of the following herbaceous components. *These fields are required.* These estimates do not count species overlap within a herbaceous component.

The percent canopy cover can be obtained from an inventory sample, for example ocular plant composition plot or cover-frequency transect. If the canopy cover estimates are obtained in this fashion, then derive the percent canopy cover value from the appropriate form. If no inventory sample has been done, then estimate the percent canopy cover for each component.

F108: GRAMINOID (3-NUM)

Graminoid cover.

F109: FORB (3-NUM)

Forb cover.

F110: FERN (3-NUM)

Fern and allies cover, including *Lycopodium* spp. and *Selaginella* spp. at ≤ 6.5 feet.

F111: MOSS & LICHEN (3-NUM)

Moss, lichen, fungi, and other bryophytes.

Table GF-16. COVER TYPES

CODE	COVER TYPE
F001	jack pine
F005	balsam fir
F012	black spruce
F013	black spruce - tamarack
F014	northern pin oak
F015	red pine
F016	aspen
F017	pin cherry
F018	paper birch
F019	gray birch - red maple
F020	white pine - northern redoak - red maple
F021	eastern white pine
F022	white pine - hemlock
F023	eastern hemlock
F024	hemlock - yellow birch
F025	sugar maple - beech - yellowbirch
F026	sugar maple - basswood
F027	sugar maple
F028	black cherry - maple
F030	red spruce - yellow birch
F031	red spruce - sugar maple -beech
F032	red spruce
F033	red spruce - balsam fir
F034	red spruce - Fraser fir
F035	paper birch - red spruce -balsam fir
F037	northern white cedar
F038	tamarack
F039	black ash - American elm -red maple
F040	post oak - blackjack oak
F042	bur oak
F043	bear oak
F044	chestnut oak
F045	pitch pine
F046	eastern red cedar
F050	black locust
F051	white pine - chestnut oak
F052	white oak - black oak - northern red oak
F053	white oak
F055	northern red oak
F057	yellow poplar
F058	yellow poplar - eastern hemlock
F059	yellow poplar - white oak-northern red oak
F060	beech - sugar maple
F061	river birch - sycamore
F062	silver maple - American elm
F063	cottonwood
F064	sassafras - persimmon
F065	pin oak - sweetgum
F066	ashe juniper - redberry (Pinchot) juniper
F067	mohrs (shin) oak
F068	mesquite
F069	sand pine
F070	longleaf pine
F071	longleaf pine - scrub oak
F072	southern scrub oak
F073	southern red cedar
F074	cabbage palmetto
F075	shortleaf pine
F076	shortleaf pine - oak
F078	Virginia pine - oak
F079	Virginia pine
F080	loblolly pine - shortleaf pine
F081	loblolly pine
F082	loblolly pine - hardwood
F083	longleaf pine - slash pine
F084	slash pine
F085	slash pine - hardwood
F087	sweetgum - yellow poplar
F088	willow oak - water oak - diamondleaf oak
F089	live oak
F091	swamp chestnut oak - cherrybark oak
F092	sweetgum - willow oak
F093	sugarberry - American elm-green ash
F094	sycamore - sweetgum - American elm
F095	black willow
F096	overcup oak - water hickory
F097	Atlantic white cedar
F098	pond pine
F100	pondcypress
F101	baldcypress
F102	baldcypress - tupelo
F103	water tupelo - swamp tupelo
F104	sweetbay - swamp tupelo -redbay
F105	tropical hardwoods
F106	mangrove
F107	white spruce
F108	red maple
F109	hawthorn
F110	black oak
F111	south Florida slash pine
F201	white spruce
F202	white spruce paper birch
F203	balsam poplar
F204	black spruce
F205	mountain hemlock
F206	Engelmann spruce - subalpine fir
F207	red fir
F208	whitebark pine
F209	bristlecone pine
F210	interior Douglas-fir
F211	white fir
F212	western larch
F213	grand fir
F215	western white pine
F216	blue spruce
F217	aspen
F218	lodgepole pine
F219	limber pine

CODE	COVER TYPE
F220	Rocky Mountain juniper
F221	red alder
F222	black cottonwood - willow
F223	Sitka spruce
F224	western hemlock
F225	western hemlock - Sitka spruce
F226	coastal true fir - hemlock
F227	western red cedar - western hemlock
F228	western red cedar
F229	Pacific Douglas-fir
F230	Douglas-fir western hemlock
F231	Port-Orford-cedar
F232	redwood
F233	Oregon white oak
F234	Douglas-fir - tan oak - Pacific madrone
F235	cottonwood - willow
F236	bur oak
F237	interior ponderosa pine
F238	western juniper
F239	pinyon - juniper
F240	Arizona cypress
F241	western live oak
F242	mesquite
F243	Sierra Nevada mixed conifer
F244	Pacific ponderosa pine -Douglas-fir
F245	Pacific ponderosa pine
F246	California black oak
F247	Jeffrey pine
F248	knobcone pine
F249	canyon live oak
F250	blue oak - digger pine
F251	white spruce - aspen
F252	paper birch
F253	black spruce - white spruce
F254	black spruce - paper birch
F255	California coast live oak
F256	California mixed subalpine
R101	bluebunch wheatgrass
R102	Idaho fescue
R103	green fescue
R104	antelope bitterbrush - bluebunch wheatgrass
R105	antelope bitterbrush - Idaho fescue
R106	bluegrass scabland
R107	western juniper - big sagebrush - bluebunch wheatgrass
R108	alpine Idaho fescue
R109	ponderosa pine - shrubland
R110	ponderosa pine - grassland
R201	blue oak woodland
R202	coast live oak woodland
R203	riparian woodland
R204	north coastal shrub
R205	coastal sage shrub
R206	chamise chaparral
R207	scrub oak mixed chaparral

CODE	COVER TYPE
R208	ceanothus mixed chaparral
R209	montane shrubland
R210	bitterbrush
R211	creosote bush scrub
R212	blackbush
R213	alpine grassland
R214	coastal prairie
R215	valley grassland
R216	montane meadows
R217	wetlands
R301	bluebunch wheatgrass - blue grama
R302	bluebunch wheatgrass - Sandberg bluegrass
R303	bluebunch wheatgrass - western wheatgrass
R304	Idaho fescue - bluebunch wheatgrass
R305	Idaho fescue - Richardson needlegrass
R306	Idaho fescue - slender wheatgrass
R307	Idaho fescue - threadleaf sedge
R308	Idaho fescue - tufted hairgrass
R309	Idaho fescue - western wheatgrass
R310	needle-and-thread - blue grama
R311	rough fescue - bluebunch wheatgrass
R312	rough fescue - Idaho fescue
R313	tufted hairgrass - sedge
R314	big sagebrush - bluebunch wheatgrass
R315	big sagebrush - Idaho fescue
R316	big sagebrush - rough fescue
R317	bitterbrush - bluebunch wheatgrass
R318	bitterbrush - Idaho fescue
R319	bitterbrush - rough fescue
R320	black sagebrush - bluebunch wheatgrass
R321	black sagebrush - Idaho fescue
R322	curlleaf mountain-mahogany - bluebunch wheatgrass
R323	shrubby cinquefoil - rough fescue
R324	threetip sagebrush - Idaho fescue
R401	basin big sagebrush
R402	mountain big sagebrush
R403	Wyoming big sagebrush
R404	threetip sagebrush
R405	black sagebrush
R406	low sagebrush
R407	stiff sagebrush
R408	other sagebrush types
R409	tall forb
R410	alpine rangeland
R411	aspen woodland
R412	juniper - pinyon woodland
R413	Gambel oak
R414	salt desert shrub
R415	curlleaf mountain-mahogany
R416	true mountain-mahogany
R417	littleleaf mountain-mahogany
R418	bigtooth maple
R419	bittercherry
R420	snowbush

CODE	COVER TYPE
R421	chokecherry - serviceberry - rose
R422	riparian
R501	saltbush - greasewood
R502	grama - galleta
R503	Arizona chapparal
R504	juniper - pinyon pine woodland
R505	grama - tobosa shrub
R506	creosotebush - bursage
R507	palo verde - cactus
R508	creosotebush - tarbush
R509	oak - juniper woodland and mahogany - oak
R601	bluestem prairie
R602	bluestem - prairie sandreed
R603	prairie sandreed - needlegrass
R604	bluestem - grama prairie
R605	sandsage prairie
R606	wheatgrass - bluestem - needlegrass
R607	wheatgrass - needlegrass
R608	wheatgrass - grama - needlegrass
R609	wheatgrass - grama
R610	wheatgrass
R611	blue grama - buffalograss
R612	sagebrush - grass
R613	fescue grassland
R614	crested wheatgrass
R615	wheatgrass - saltgrass - grama
R701	alkali sacaton - tobosa grass
R702	black grama - alkali sacaton
R703	black grama - sideoats grama
R704	blue grama - western wheatgrass
R705	blue grama - galleta
R706	blue grama - sideoats grama
R707	blue grama - sideoats grama - black grama
R708	bluestem - dropseed
R709	bluestem - grama
R710	bluestem prairie
R711	bluestem - sacahuista prairie
R712	galleta - alkali sacaton
R713	grama - muhly - threeawn
R714	grama - bluestem
R715	grama - buffalograss
R716	grama - feathergrass
R717	little bluestem - indiangrass - Texas wintergrass
R718	mesquite - grama
R719	mesquite - liveoak - seacoast bluestem
R720	sand bluestem - little bluestem dunes
R721	sand bluestem - little bluestem plains
R722	sand sagebrush - mixed prairie
R723	sea oats
R724	sideoats grama - new Mexico feathergrass - winterfat
R725	vine mesquite - alkali sacaton
R726	cordgrass
R727	mesquite - buffalograss
R728	mesquite - granjeno - acacia

CODE	COVER TYPE
R729	mesquite
R730	sand shinnery oak
R731	cross timbers - Oklahoma
R732	cross timbers - Texas (little bluestem - post oak)
R733	juniper - oak
R734	mesquite - oak
R735	sideoats grama - sumac - juniper
R801	savanna
R802	Missouri prairie
R803	Missouri glades
R804	tall fescue
R805	riparian
R806	gulf coast salt marsh
R807	gulf coast fresh marsh
R808	sand pine scrub
R809	mixed hardwood and pine
R810	longleaf pine - turkey oak hills
R811	south Florida flatwoods
R812	north Florida flatwoods
R813	cutthroat seeps
R814	cabbage palms flatwoods
R815	upland hardwood hammocks
R816	cabbage palm hammocks
R817	oak hammocks
R818	Florida salt marsh
R819	freshwater marsh and ponds
R820	Everglades flatwoods
R821	pitcher plant bogs
R822	slough
R901	alder
R902	alpine herb
R903	beach wildrye - mixed forb
R904	black spruce - lichen
R905	bluejoint reedgrass
R906	broadleaf forest
R907	dryas
R908	fescue
R909	freshwater marsh
R910	hairgrass
R911	lichen tundra
R912	low scrub shrub birch - ericaceous
R913	low scrub swamp
R914	mesic sedge - grass - herb meadow tundra
R915	mixed herb - herbaceous
R916	sedge - shrub tundra
R917	tall shrub swamp
R918	tussock tundra
R919	wet meadow tundra
R920	white spruce - paper birch
R921	willow

POTENTIAL VEGETATION DATA

The data in this grouping (fields 112-117) provides information on the potential vegetation (plant association, habitat type, or climax plant community). ***Complete the formation field (field 112) for all plots. Complete the remaining fields only if a published potential vegetation classification exists.*** A partial list of classifications is in Appendix E.

F112: FORMATION (2 CHAR)

Describe the potential vegetation formation (Table GF-17) of your plot. *(The first column is a rough grouping to assist the examiner in finding the correct code – it is not to be coded on the field form!)* Obtain the formation information from the published classification or as the examiner's best professional approximation.

Required ***Accuracy Standard = Good Judgment***

Table GF-17. PNV FORMATION TYPES

	CODE	DESCRIPTION
forest	CF	Coniferous upland forest
	BF	Broadleaf upland forest
	CW	Coniferous-dominated wetland
	BW	Broadleaf-dominated wetland
shrub	SU	Shrub-dominated upland
	SA	Shrub-dominated alpine
	SW	Shrub-dominated wetland
herb	HU	Herbaceous-dominated upland
	HA	Herbaceous-dominated alpine
	HW	Predominately herbaceous (graminoid, forb, fern) wetland
other	AQ	Aquatic
	ML	Moss/lichen-dominated
	NV	Non-vegetated terrestrial (sand dunes, scree, rock)
	OT	Other type — specify in comments
	X	Unable to assess

F113: POTENTIAL NATURAL VEGETATION — REFERENCE ID (4-CHAR AND 2-NUM)

This field identifies the publication or reference by which the potential vegetation is classified. The first four characters identify the author(s). The last two characters identify the year of publication. For a single author, use the first four letters of the last name, for example, "COOP75" for the citation:

> Cooper, S. V. 1975. Forest habitat types of northwestern Wyoming and contiguous portions of Montana and Idaho, *etc.*

For a reference written by two authors, use the first two letters of each author's last name, in the order they are cited; for example, "MUST80" for the citation:

> Mueggler, W.F. and Stewart, W. L. 1980. Grassland and shrubland habitat types of western Montana, *etc.*

For a reference with more than two authors, use the first two letters of the last name of the first author, then the letters O T for "and others"; for example, "PFOT77" for the citation:

> Pfister, R. D.; Kovalchik, B. D.; Arno, S. F.; and Presby, R. C. 1977. Forest habitat types of Montana, *etc.*

A partial list of classifications is in Appendix E.

Required, if a classification exists
Accuracy Standard = No Errors

NOTE: Whenever a plant species symbol is required, use the 8-character alpha-numeric codes from the Natural Resource Conservation Service's PLANTS data base. Lists of all species by state are available.

F114: INDICATOR SPECIES 1 (8-CHAR)

Enter the 8-character alpha-numeric code of the overstory indicator species that describes the potential vegetation classification of your plot. This is the same as series level classification (for example, grand fir = ABGR). This species may be any life form, dependent on the potential vegetation type. If you are unable to make this assessment, enter an "X" in this field.

Required, if a classification exists
Accuracy Standard = Good Judgment

F115: INDICATOR SPECIES 2 (8-CHAR)

Enter the 8-character alpha-numeric code of the understory indicator species that describes the potential vegetation classification of your plot. This is the same as climax community type, association, or habitat type level classification (for example, fields 114 and 115 equals habitat type: ABGR/ASCA). This species may be any life form, dependent on the potential vegetation type. If you are unable to make this assessment, enter an "X" in this field.

Required, if a classification exists
Accuracy Standard = Good Judgment

F116: INDICATOR SPECIES 3 (8-CHAR)

Enter the 8-character alpha-numeric code of an additional understory indicator species that describes the potential vegetation classification of your plot. This is the same as habitat type phase (for example, fields 114, 115, and 116 equals habitat type phase: ABGR/ASCA/TABR). This species may be any life form, dependent on the potential vegetation type. If you are unable to make this assessment, enter an "X" in this field.

Required, if a classification exists
Accuracy Standard = Good Judgment

F117: SITE PHASE (8-CHAR)

Enter alpha-numeric code to describe the primary site phase of the plot. Site phase is rarely identified in potential vegetation classifications. If that is the case, enter an "X" in this field.

Required, if a classification exists
Accuracy Standard = Good Judgment

TREE DATA

This data is intentionally sketchy. If complete information regarding the tree portion of a plot is required, then a full stand exam or equivalent will be conducted. The purpose of this data is to give a thumb-nail impression of both live and dead trees. Basal area information can be obtained quickly and easily. Examiners can be trained in approximately five minutes on how to use a prism.

This information is optional, but if collected on forested or woodland sites will aid in coarse level stratification of large data bases. This is especially important at forest and region analyses levels. Collect tree data for both live and dead trees.

F118 & F123: BASAL AREA FACTORS (2-NUM)

A different basal area factor (BAF) may be used for live trees and dead trees. In fact, this is encouraged because the density of dead trees is normally significantly less than live trees. Record the BAF used for live and for dead trees, respectively.

Select a BAF that will result in a count, or basal area number (BAN) of 7-10 individuals. Basal area measurements using a prism or Relaskop are designed to most accurate with a BAN within that range. Consequently a BAF of 20 feet^2/acre may be appropriate for live trees, while a BAF of 5 or 10 feet^2/acre may be needed for dead trees.

A BAF of 10 usually works fairly well for open stands on a 0.10 acre plot. A BAF of 20 or 40 works better for denser stands where trees might hide one another. A BAF of 5 works fairly well for sparse park-like stands.

Optional ***Accuracy Standard = No Errors***

F119 & F124: BASAL AREA NUMBERS (2-NUM)

Use a variable-factor prism, angle gauge, or Relaskop to count the number of trees that have a width at breast height greater than the projected angle. Record the BAN for live and dead trees, respectively.

Optional ***Accuracy Standard = ± 1 tree count***

BASAL AREA (3-NUM)

Enter the basal area in square feet per acre (feet^2/ac), for all trees, live or dead, respectively. Determine the basal area by multiplying the BAF by the BAN. Should there be so few trees that none fall within the variable radius plot, yet the examiner can determine that there is one foot^2 or more of basal area represented by the plot, a value less than the BAF is estimated. Enter "0" if no live tree basal area exists.

Optional
Accuracy Standard = ± 1 tree count times the BAF

F120 & F125: AVERAGE DIAMETER AT BREAST HEIGHT (3-NUM)

Estimate from several measurements and an ocular evaluation the average diameter at breast height of the dominant live tree layer (greatest canopy volume) and the upper dead tree size class layer to the nearest whole inch. The diameter is the average at breast height (4.5 feet above the ground) and includes all live trees greater than 4.5 feet tall.

Optional
Accuracy Standard = ± 1" for DBH when trees are < 10" and ± 2" for DBH when trees are ≥ 10"

F121 & F126: AVERAGE HEIGHT OF DOMINANT LIVE TREE LAYER (3-NUM)

Estimate from several measurements and an ocular evaluation the average height of the dominant live tree layer (greatest canopy volume) and the upper dead tree size class layer to the nearest foot.

Optional ***Accuracy Standard = ± 10 percent***

F122: AVERAGE AGE OF DOMINANT LIVE TREE LAYER (4-NUM)

Enter the average age of the dominant live tree layer (greatest canopy volume). This is best done by counting rings from an increment core of an "average" dominant tree. It can also be done from stump ring counts or knowledge of the area.

Optional ***Accuracy Standard = ± 10 percent***

DRY WEIGHT PRODUCTION

Estimate the peak annual dry weight production in pounds per acre (lbs/ac) for each life form. For herbaceous material estimate the current year's leaf growth. For woody species estimate the current year's leaf and leader growth plus the previous year's leader growth. Enter "-1" if production was not assessed. Enter "0" if production was assessed, but a particular life form was not present. Estimating dry weight production is optional; of the six categories, shrub, graminoid, and forb are the most important.

These measurements are based, as a minimum, on four subjectively placed plot frames located in representative portions of four quarter sections of the plot. Any size plot frame mentioned in the Inventory Chapter (Table PD-1) can be used to estimate production.

GREEN WEIGHT

Ocularly estimate the green weight by life form in pounds per acre. If you estimate green weight and multiply it by a conversion factor to help estimate dry weight, then estimate green weight in pounds per acre. This value is not entered into the data base for analysis.

Optional

DRY WEIGHT FACTOR

If you estimate green weight per acre, enter an estimated conversion factor expressed as a decimal. Use dry weight factors (Table PD-2) or data from actual clipping studies to calculate dry weight conversion factors. Conversion values are not entered into the data base for analysis.

Optional

F127: TREE (4-NUM)

Tree species production (< 6.5 feet). *Note: Emphasis on "optional".*

Optional ***Accuracy Standard = ±100 lbs/acre***

F128: SHRUB (4-NUM)

Shrub species production (< 6.5 feet).

Optional ***Accuracy Standard = ±100 lbs/acre***

F129: GRAMINOID (4-NUM)

Graminoid species production.

Optional ***Accuracy Standard = ±100 lbs/acre***

F130: FORB (4-NUM)

Forb species production.

Optional ***Accuracy Standard = ±100 lbs/acre***

F131: FERN (4-NUM)

Fern and fern allies species production.

Optional ***Accuracy Standard = ±100 lbs/acre***

F132: MOSS (4-NUM)

Moss, lichen, and other bryophyte species production (< 6.5 feet).

Optional ***Accuracy Standard = ±100 lbs/acre***

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GENERAL FIELD DATA **Spatial ID** (F1): FS - 02 - 12 - 10 - 373010830 - 0045 - 94

(R2-2200-GF) **Comparison Plot** (F2): _-_-_-_-_-_

Purpose/Project: Table Mesa Red Bluff

Picture Start #: ___ **Date** (F3): ________ (MMDDYYYY) **Event Type** (F4): _____

	Last	First	M.I.
Crew Leader (F5):	Bremerton	Maxwell	J
Observer (F6):			
Observer (F7):			

Was GPS data collected for the plot? If yes, GPS File Name: ________, otherwise continue with location data. The location data block is ***optional*** if GPS data is collected.

QUAD MAP	ID # (F8)	Series (F9)	Name (F10)	State	County
	373010830	07.5	Boggy Draw	CO	93

AERIAL PHOTO	Date (F11)	Source (F12)	Scale (F13)	Proj/Code (F14)	Flt Line(F15)	Roll #(F16)	Exp #(F17)
	__/__/____	______	1:______	________	___	___	___

		Degrees	Minutes	Seconds
Latitude (F18-20)	N	39	58	05.30
Longitude (F21-23)	W	107	36	38.10

or

UTM North (F24): 43160505

UTM East (F25): 2748592

Elev (F26): 3051 **Proj Year** (F27): 27

LEGAL ID	Township (F28)	Range (F29)	Section (F30)	¼ Section (F31)	¼ ¼ Section (F32)	Prime Merid (F33)
	12S	91W	31	SW	NE	6

WATERSHED HIERARCHY	5th level (F34)	6th level (F35)	7th level (F36)	8th level (F37)	9th level (F38)
	____________	__	__	__	__

Only the horizon angle fields in this block are ***optional***.

PLOT SIZE	Radius – or – Length (F39)	Width (F40)	UofM (F41)	Remeasure Interval (F42)
	53	0	FT	10

SITE DATA	Elevation (F43)	UofM (F44)	Declination (F45)	Aspect (F46)	Slope (F47)	UofM (F48)
	9160	FT	0	10	15	PC

Special Feature (F49)	Vertical Shape (F50)	Horizontal Shape (F51)	Geologic Group (F52)	Lithologic Group (F53)	Lithologic Member (F54)
NA	CV	L	S	SH	Km

Erosion Status (F55)	Erosion Type (F56)	East Horizon (F57)	South Horizon (F58)	West Horizon (F59)
ST	NA	3 opt.	5 opt.	2 opt.

GENERAL FIELD DATA **Spatial ID** (F1): FS - 02 - 12 - 10 - 373010830 - 0045 - 94

GROUND COVER: required, except when Cover-Frequency data is collected; sample size presumed to be same as for General Field Data (previous page).

Wood:	F60: 2		**Bare Soil (< 1/16" diameter):**	F66: 20
Litter/Duff/Ash:	F61: 60	**Depth** (F62): ___ ___ . ___	**Gravel (1/16 - 3" diameter):**	F67: 5
Moss/Lichen/Fungus/Alga:	F63: 5	**opt.**	**Cobble (3-10" diameter):**	F68: 1
Basal Vegetation:	F64: 3		**Stone (10-24" diameter):**	F69: 1
Water:	F65: 0		**Boulder (>24" diameter):**	F70: 0
			Bedrock:	F71: 0

The fuel and large woody debris data fields are *optional*.

Fuel Model (F72)	**Fuel Depth** (F73)	**UofM** (F74)	**Downed Log Diameter** (F75)	**UofM** (F76)	**# Woody Pieces > 3"** (F77)
___ ___	___ ___ . ___	___ ___	___ ___ ___	___ ___	___ ___ ___

MAJOR DISTURBANCES	**Disturbance Type**	**Date of Disturbance**	**Disturbance Intensity**	**Disturbance Periodicity**
F78-81	BU WN	1920	S	75
F82-85				
F86-89				

ANIMAL EVIDENCE F90 DE F91 EL F92 CA F93 ___ ___ F94 ___ ___ F95 ___ ___

SRM or SAF Cover Type (F96): F217

CANOPY COVER BY LIFEFORM AND SIZE CLASS							
Tree: (F97-103)	Total: 15	Seedling: 10	Sapling: 10	Pole: ___ ___ ___	Medium: ___ ___ ___	Large: ___ ___ ___	V Large: ___ ___ ___
Shrub: (F104-107)	Total: 25	Low: 5	Middle: 25	Tall: ___ ___ ___			
Herb: (F108-111)	Gram: 55	Forb: 35	Fern: ___ ___ ___	Moss: ___ ___ ___			

POTENTIAL VEGETATION F112: BF F113: ___ ___ ___ ___—___ ___ **opt.**

Formation, always required **Classification Reference Identification**

F114: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ **Indicator Species #1 opt.**

F115: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ **Indicator Species #2 opt.**

F116: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ **Indicator Species #3 opt.**

F117: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ **Site Phase opt.**

The basal area and forage production data fields are *optional*.

LIVE TREE	F118: ___ ___ **BAF**	F119: ___ ___ **BAN**	___ ___ ___ **BA**	F120: ___ ___ ___ **DBH**	F121: ___ ___ ___ **Height**	F122: ___ ___ ___ ___ **Age**
DEAD TREE	F123: ___ ___ **BAF**	F124: ___ ___ **BAN**	___ ___ ___ **BA**	F125: ___ ___ ___ **DBH**	F126: ___ ___ ___ **Height**	

DRY WEIGHT PRODUCTION		**Grn Wt**	**DWF**	**Dry Weight**		**Grn Wt**	**DWF**	**Dry Weight**
	Tree (F127):	______	____	___ ___ ___ ___	**Shrub** (F128):	______	____	___ ___ ___ ___
	Gram (F129):	______	____	___ ___ ___ ___	**Forb** (F130):	______	____	___ ___ ___ ___
	Fern (F131):	______	____	___ ___ ___ ___	**Moss** (F132):	______	____	___ ___ ___ ___

EXHIBIT RH: RANGELAND HEALTH EVALUATION MATRIX
R2-2200-RH

This form is a "quick and dirty" process of focusing the examiner's eye on critical rangeland health features. Qualitative evaluation of these features can lead the examiner towards an accurate initial assessment of the rangeland and the management of that rangeland.

This checklist is based on Table 4-8 (pages 130-131) of National Research Council (1994). The original form has been field tested and modified, to better meet the needs of the Rocky Mountain Region.

EXHIBIT CD: COMMENTS DATA
R2-2200-CD

GENERAL DISCUSSION

This form is used to record all comments for a plot, regardless of the types of sampling methods used. The data base allows the examiner to enter as many lines of comments as Required The following data are recorded for Form R2-2200-CD.

Ensure that a complete description of the plot location is included in the comments. A road or trail log, including road/trail numbers, mileages, and direction; reference site description; distance and bearing to the plot center; and plot center description is essential for successfully relocating any plot.

SPATIAL IDENTIFIER (23-CHAR)

Enter the Spatial ID identified in Field 1 of the General Field Data Form (R2-2200-GF).

Required ***Accuracy Standard = No Errors***

COMMENTS (240-CHAR)

This field is used to record up to 240 characters of comments per line number ID. You may enter as many lines of comments as you need in the data base, despite the fact that the field form only displays eight line record entries. Continue on another field sheet if you need to record additional comments.

The following is a partial listing of items you should consider for the comment field.

Include comments concerning location, key environmental features, vegetation relationships, history, and disturbance factors not identified in other fields.

Identify adjacent communities and indicate whether they are on wetter or drier sites. Discuss why adjacent communities are different if they are on the same kind of site.

Exhibit RH: Rangeland Health Evaluation

RANGELAND HEALTH EVALUATION Spatial ID: ______________________________

MATRIX (R2-2200-RH) **Purpose/Project:** ____________________/____________________

Observer should rate health of site by evaluating relative mix of the following characteristics.

INDICATOR	*HEALTHY*	*AT RISK*	*UNHEALTHY*
		Phase 1: Abiotic Characteristics	
A-horizon	☐ Present and distribution unfragmented	☐ Present but fragmented distribution developing	☐ Absent, or present only in association with prominent plants or with other obstructions
Pedestaling	☐ No pedastaling of plants or rocks	☐ Pedestals present, but on mature plants only; no roots exposed	☐ Most plants and rocks pedestaled; roots exposed
Rills and gullies	☐ Absent, or with blunted and muted features	☐ Small, embryonic, and not connected into a dendritic pattern	☐ Well defined, actively expanding, dendritic pattern established
Scouring or sheet erosion	☐ No visible scouring or sheet erosion	☐ Patches of bare soil or scours developing	☐ Bare areas and scours well developed and contiguous
Sedimentation or dunes	☐ No visible soil deposition	☐ Soil accumulating around plants or small obstructions	☐ Soil accumulating in large barren deposits or dunes or behind large obstructions
		Phase 2: Rangeland Vegetation Conditions	
Dominant native perennial grasses and forbs	☐ Present and well distributed across site	☐ Present only in protected areas (under shrubs), or suppressed	☐ Absent or only in very minor amounts
Native plants that normally occur in minor amounts (<5%)	☐ Present in normal amounts (e.g., junegrass or American vetch)	☐ Plants tending to occur in more than normal amounts	☐ These species dominate the site: mule's ear, golden banner, or senecio
Shrubs	☐ Present in normal amounts, often in mosaic pattern	☐ Beginning to dominate the site	☐ Dominating the site to the exclusion of other species
Shrub growth form and hedging	☐ Normal, lightly hedged, twigs available, vigorous	☐ Branches becoming clubbed, ragged looking, less vigorous	☐ Plants clubbed, unavailable, twig vigor low
Fire history (if appropriate)	☐ Fire present in recent years	☐ Minimal fire evidence	☐ Fire has been excluded for long time (beyond normal parameters)
Age-class distribution	☐ Distribution reflects all species	☐ Seedlings and young plants missing	☐ Primarily old or deteriorating plants present
		Phase 3: Recovery mechanisms	
Litter distribution and incorporation	☐ Uniformly distributed across site, replaced annually, and present in spring		☐ Litter largely absent
Plant vigor, including shrubs	☐ Plants display normal growth form	☐ Plants developing abnormal growth form	☐ Most plants in abnormal growth form
Germination microsite	☐ No obvious limitations such as crusts	☐ Developing crusts, soil movement, or other factors degrading microsites; developing crusts fragile	☐ Soil movement or crusting sufficient to inhibit most germination and seedling establishment

Overall Rating (Narrative Summary): ____

____

COMMENTS DATA
(R2-2200-CD)

Spatial ID: ______________________________

Photo of Site (for temporary transects)

Comments (Continue on additional sheets, if necessary.)

1	
2	
3	
4	

RANGELAND MONITORING AND EVALUATION

INTRODUCTION

Rangeland monitoring and evaluation are essential to good rangeland management. Monitoring and evaluation can be described as the gathering of sufficient information so the manager knows what is happening to the rangeland resources and why it is happening. Goals and objectives in the Forest Plan and allotment management plan (AMP) portray a vision of desired condition of allotment resources. The intent of monitoring and evaluation is to test the success of the prescribed management strategy in accomplishing these goals and objectives.

Rangeland monitoring attempts to analyze effects of management on the entire ecosystem involved. Ecosystem management dictates that monitoring methods be diverse. This guide sets forth a menu of the most common and acceptable monitoring methods for use in the Rocky Mountain Region. These methods are not necessarily all-inclusive. In many situations, range personnel will need assistance from additional resource specialists to suggest and implement monitoring methods not described in this guide.

Adequate monitoring programs have value to the Forest Service, to permittees, and to various individuals or groups interested in rangeland resources. Proper monitoring will accomplish the following:

- Determine permittee compliance with the and annual operating instructions.
- Verify results against prescribed management objectives. If progress towards objectives is not occurring, the manager can use the monitoring information to adjust the management strategy, or to determine if objectives are unrealistic.
- Firm up grazing capacity estimates.
- Provide necessary information to develop annual operating instructions.
- Identify the need to revise allotment management actions, such as grazing strategy and improvement needs.
- Provide estimates of trend with respect to desired condition or desired plant community.
- Determine impacts from livestock and other uses on rangeland resources.
- Provide a data base of information for reporting.

The intensity of monitoring and evaluation varies between allotments based upon rangeland conditions, management complexity, conflicting interests, and controversy. Periodic ocular estimates of rangeland conditions may suffice on some allotments, while numerous resource studies involving a variety of methodologies may be needed on other allotments. Tailoring monitoring efforts to each individual allotment is an important component of allotment management planning. In general, monitoring efforts will be greatest during the years immediately following implementation of a new allotment management plan. Usually this extends through the first full cycle of the management system, at which time the system should be operating smoothly and opportunities for improvement found and applied.

TYPES OF MONITORING

Monitoring is classified into three types: implementation, effectiveness, and validation.

IMPLEMENTATION MONITORING

Implementation monitoring determines whether standards and management practices are implemented as detailed in the AMP and Forest Plan. The question asked with this type of monitoring is: "Did we do what we said we were going to do?" Implementation monitoring includes allotment inspections and utilization estimates. Implementation monitoring is *short-term* monitoring.[1]

EFFECTIVENESS MONITORING

Effectiveness monitoring determines whether management practices are effective in moving the allotment towards desired condition as described in the Forest Plan and AMP objectives. The question asked is: "Did the management practices do what we wanted them to do; did they meet the objectives?" An example of effectiveness monitoring is trend studies that determine whether vegetation is moving towards the desired plant community. Effectiveness monitoring is *long-term* monitoring.[2]

VALIDATION MONITORING

Validation monitoring determines whether the information upon which standards, guidelines, and objectives are based is valid and correct. The question asked is "Is there a better way to meet Forest Plan and AMP goals and objectives?" An example of validation monitoring is the continual assessment of proper use guidelines to insure they reasonably describe the level of grazing use that encourages progress towards allotment objectives.[3]

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[1] FSH 1909.12.6.11.

[2] FSH 1909.12.6.12.

[3] FSH 1909.12.6.13.

THE ALLOTMENT MANAGEMENT PLAN

Monitoring and evaluation, like all aspects of allotment management, should be carefully analyzed and planned. All allotment management plans will have a monitoring section that describes the specific monitoring methods to be conducted on the allotment (See Planning Chapter). Monitoring allows the manager to determine if the AMP goals and objectives are being met. Following are general guidelines to consider in developing the monitoring and evaluation section of the AMP.

MONITORING GUIDELINES

1. Compliance inspections to determine accomplishment of the terms and conditions of grazing permits, AMPs, and annual operating instructions is a critical monitoring effort. Before rangeland management personnel can make any judgment on the cause of resource impacts or the trend in resource condition, there has to be the assurance that plans were followed as specified.

   Although the Forest Service has the responsibility for compliance monitoring, permittees need to take a more active role. Public scrutiny of rangeland management programs demands that permittees take full responsibility for compliance with grazing permits and relevant management plans. Non-compliance with the terms and conditions of a grazing permit cannot be tolerated nor allowed to continue, and should be followed by permit action. Involvement by the permittee in compliance monitoring will enable Forest Service rangeland managers to spend more of their limited time on planning and implementation of management strategies for allotments not in compliance with Forest Plans.

2. Monitoring techniques that collect measurable resource attributes are more accurate and defensible. Subjective monitoring techniques should be kept to a minimum.

3. The monitoring and evaluation effort should be commensurate with the level of grazing use and the complexity of the overall allotment situation. Resource constraints, such as personnel and funding availability, should be factored into keeping monitoring simple and realistic.

4. Develop the monitoring plan as a schedule, with specific assignments, techniques to be utilized, precision and confidence limits, and time frames.

5. **DOCUMENT! DOCUMENT! DOCUMENT!** Each monitoring section should identify how and where the monitoring information will be recorded and filed.

6. The monitoring section will be developed jointly with permittees and other interested persons or groups. Some monitoring efforts can, and should, be assigned to the permittee, or others. The Forest Service is responsible for ensuring that monitoring by others meets specified standards and is documented appropriately. Monitoring techniques that determine range readiness and utilization levels are easily learned and quickly accomplished through a partnership approach with permittees or others.

KEY AREAS AND BENCHMARKS

The use of key areas and benchmarks allows for sampling of relatively small areas of the allotment and extrapolation of the results to much larger areas. The key area and benchmark concept is based on the premise that evaluations of correctly identified small areas are reliable indicators of grazing impacts on the entire unit or allotment. Depending on management objectives, benchmarks and key areas may be representative samples of a large stratum such as a pasture or allotment, or they may be representative of a much smaller area with important value such as a riparian zone, critical nesting habitat for grouse, or a special plant community.

Benchmarks and key areas are selected because they provide valuable resource information. Range personnel should be aware of disturbances or changes in livestock use patterns that may cause the areas to no longer be representative. Benchmarks and key areas may need to be changed or new ones selected when the pattern of use is significantly modified because of differences in season of use, kinds and classes of livestock, pasture size, and water supplies. Keep information from abandoned benchmarks or key areas to provide a historical background for future analysis.

In many cases the benchmarks and key areas identified for resource inventory can also be used for monitoring. Delineate benchmarks and key areas accurately on aerial photos and the allotment map. Benchmarks and key areas have slightly different meanings and purposes.

KEY AREAS

Key areas are:

> "...a portion of the range, which, because of its location, grazing or browsing value, and/or use, serves as an indicative sample of range conditions, trend, or degree of use seasonally. A key area guides the general management of the entire area of which it is part." (SRM 1974).

Key areas are usually selected for monitoring studies to determine if management objectives are being met.

Key areas are usually five acres or more and are selected as sites where prescribed use will occur first. Also included are sites where use must be closely monitored because of management plan requirements, such as riparian areas or areas where threatened, endangered, or sensitive species may occur. These locations will vary by grazing strategy. There will probably be several key areas per allotment. Locations of key areas should be identified in the and delineated on the allotment map.

BENCHMARKS

Benchmarks are reference points that are sensitive to management changes. These are the small areas where *long-term* trend studies are installed and maintained so that the manager can assess the resource impacts from management.

Selection of benchmarks for long-term trend studies is an important task, and should be carefully evaluated. Benchmarks should be selected by experienced personnel familiar with the allotment. There should be agreement on the locations of benchmarks with permittees, and other interested agencies and individuals. Interdisciplinary team personnel should also be involved with selection of benchmarks, and the types of studies to be conducted in their related field of expertise. Benchmarks should be representative of the area in which they are located. They should be located away from fence lines, roads, salt grounds, water developments, recreation facilities, and other features that may concentrate use or otherwise cause disturbance.

The ecological characteristics of the benchmark site should be well understood, including existing vegetation, ecological type, and wildlife species using the area. Evaluation and adjustments in the management system should only be made by persons with a working knowledge of the entire ecosystem.

STATISTICAL CONSIDERATIONS FOR MONITORING

Rangeland management is both an art and a science. In other words, good management can only occur through professional judgment based upon precise data. Information based upon judgment should not be confused with information collected through scientific study. It should also be clear that good decisions are based upon a combination of both judgment and science, never one exclusive of the other. Managers must make every effort possible to insure *all* information used to make decisions is correct.

Many monitoring methods discussed in this chapter (specifically rangeland use and trend determinations) are for plot level sampling of vegetative characteristics. The rangeland manager and decision-maker must be reasonably sure that the data collected through sampling accurately represents the overall population.[4]

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[4] Appendix C contains information managers can use to support decisions with statistical analysis.

SHORT-TERM MONITORING

Short-term (implementation) monitoring methods described in this guide include: range readiness, allotment inspections, forage production, vegetative residue methods, utilization methods, streambank alteration, and wildlife pellet group counts.

RANGE READINESS

Early spring use by livestock on most National Forest range allotments with traditional, continuous, deferred, or rest rotation grazing systems can be detrimental to vegetation reproduction and establishment of new plants. Indicators used to determine range readiness are soil and vegetation conditions. Rangeland is generally ready for grazing when soil has become firm after winter and early spring precipitation, and when plants have reached the defined stage of growth at which grazing may begin under a specific management plan without long-lasting damage. Rangeland is generally ready when cool-season grasses are headed out, forbs are in full bloom, and brush is leafed out.

The concept of range readiness has changed somewhat in current years. Application of Holistic Management (Savory), riparian management techniques, and livestock grazing to improve forage quality for wintering wildlife has demonstrated that livestock use prior to traditional range readiness can actually benefit rangeland conditions. The key to the success of these new management systems is the ability to graze the important forage species early and then allow sufficient regrowth before further use. Range readiness dates will vary between allotments with differing resource attributes and management systems. Before establishing turn-on dates that are earlier than traditional range readiness, the rangeland manager must be reasonably certain that the proposed management strategy will work. Early turn-on dates must be based upon documented successes in other areas with similar vegetation types and similar objectives.

Establishment of a range readiness date should be developed during the allotment management planning process. Select representative areas of the primary range for range readiness observation. Properly selected, a location may furnish data for several allotments that are uniform in elevation, exposure, soil, vegetation, climate, and prescribed management system. Successive annual observations will indicate validity of opening dates. Record range readiness observations in field inspection notes.

ALLOTMENT INSPECTIONS

Allotment inspection is an on-the-ground (and "off the main road") visit of the grazing allotment. A number of items will be monitored during each allotment inspection; however, compliance with the terms and conditions of the grazing permit(s) is the primary objective. Allotment inspections must be documented in writing. Allotment Inspection Forms of local design should be used for recording pertinent information collected during the inspection. Annual allotment inspections, including suggestions, should be consolidated and submitted to the permittee for review at the end of the season. Use of photographs or video recordings can be used to greatly enhance the documentation.

The objectives or items that you want to monitor should be decided prior to visiting the allotment. There are many items to consider during an inspection.

LIVESTOCK MANAGEMENT

- Determine livestock ownership through brands and eartags.
- Conduct livestock counts, to insure stocking does not exceed permitted numbers or is not less then 90 percent of permitted numbers.
- Validate management system compliance, including if livestock are in the correct pastures for the correct season.
- Verify that maintenance of range improvements is satisfactory; also note need for reconstruction of improvements and ideas for potential improvements such as water sources and fences.
- Inspect salting locations; identify recommended salting areas that will encourage better livestock distribution.
- Determine if sheep bedgrounds are properly located and used.
- Determine livestock distribution by describing locations and general use levels.
- Evaluate herder or rider performance.
- Document contacts with the permittee(s).

RANGE VEGETATION

- Estimate forage utilization and/or forage residue. Sketchings on a map of use intensity or forage residue levels are generally preferable to notes for recording this information.
- Estimate vigor of individual plant species. Seed production, seedling establishment, dead plant centers, and other general vegetation health characteristics are important items to observe when estimating vigor.
- Note phenology of important forage species such as specific flowering and seed maturity dates.
- Record noxious weed, rodent, insect, and poisonous plant infestations and delineate their locations on a map for future planning and control efforts.

OTHER RESOURCE CONSIDERATIONS

- Observe wildlife numbers and use patterns. Special attention should be placed on identifying threatened, endangered, or sensitive species that may exist in the area.

- Note soil conditions by assessing relative amount of displacement, compaction, rilling, gullying, surface soil losses and deposits, accumulation of litter, and other indicators.
- Inspect special concern areas to ensure that livestock are not in closed areas, such as campgrounds or Research Natural Areas.
- Note impacts to rangeland resources from other users, such as recreationists or off-road vehicles.
- Document riparian values and water quality including bank stability, apparent stream siltation, kinds and vigor of shrubs, and livestock/wildlife use patterns in riparian areas.

This list is not all-inclusive since there are numerous things encountered during an allotment inspection. An allotment inspection may be the only time a Forest Service employee visits the area during the year, so it is important to observe and document all activities and occurrences on the allotment.

The examiner should be familiar with the grazing permit, the AMP, and the annual operating instructions prior to making the examination. Knowledge of travel management regulations, wildlife management objectives, and recreation values is also desirable when performing an inspection. Take a map along to record locations of observations. Concise documentation is best, portraying facts, figures, measurements, people, and dates. Include as many specifics as possible and avoid generalities. Proper documentation is necessary to evaluate the effectiveness of the AMP, and may even be used in a court of law.

Include the permittees in allotment inspections when possible. Apart from insuring you are both looking at the same thing(s), these are good opportunities to exchange viewpoints, share information, and get to know each other. Open and honest communication during an allotment inspection can go a long way towards solving problems and designing management strategies that will help to move the range resource towards its desired condition.

FORAGE PRODUCTION

Forage production is the current growth of browse and herbaceous plants that is both palatable and available to grazing animals. Forage may vary with season of use and kind of livestock. Forage production estimates are primarily an inventory procedure (see page 3-75). Forage production measurements can also be an important part of monitoring if the observer considers the limitations of this approach.

Forage production fluctuates greatly with changes in climatic conditions. Reliable information can only be obtained from many years of production monitoring spanning climatic cycles. Estimating forage production alone is a poor method of determining stocking rates on allotments with a history of livestock use. On existing allotments, stocking rates should be determined by a combination of forage production, livestock use patterns, and trend determinations.

There is value, however, in using forage production estimates as a factor in establishing initial grazing capacity on areas without a history of grazing use. As we continue to analyze rangelands from an ecosystem (landscape scale) perspective, vegetative production will also be useful in defining resource value ratings (production potentials) for the various plant communities that may occur within an ecological type.

Production should be measured according to the procedures outlined in the Inventory Chapter (see page 3-75).

RANGELAND USE

Determining the use of forage by all herbivores is an important aspect of rangeland management. Managers must know when use occurs, to what extent, and by which animals. Use data helps the manager assess the desirable level of livestock use that moves resource conditions toward the objectives described in the allotment management plan. Level of use, timing of use, and grazing system in place determines how individual plant species are affected by livestock grazing. Livestock use is one factor influencing trend that can be readily adjusted. Use is also one of many considerations when determining grazing capacity. Rangeland use data is intended to provide information that can be used to: determine timing of pasture moves, identify distribution problems, and develop future management actions such as grazing strategies and potential improvements.

Rangeland use can be measured and expressed in two ways: the amount of forage left after grazing (residue), or the amount of forage removed by grazing (utilization). In the past, the Forest Service has primarily used utilization methods in determining rangeland use. Residue methods, by contrast, are relatively new procedures for most National Forest System lands. Residue methods and utilization methods are discussed in this chapter.

VEGETATIVE RESIDUE

There is increasing interest from the livestock industry and various resource specialists for describing proper use in terms of residue, that is, the amount of forage left after grazing.

Rangeland resource values vary considerably between geographic locations. Allotment objectives are developed to enhance and protect different resource values on each allotment. Because of specific resource values, rangeland use might be more appropriately expressed by the amount of "standing crop" left after grazing, instead of the percentage of forage removed by grazing. For example, the amount of vegetation left ungrazed is the critical factor in successful bird nesting or wildlife winter range for some rangelands. Another example occurs where a certain amount of herbage must be left to protect fragile soil from excessive erosion.

Residue guidelines should, at minimum, protect the basic health and productivity of range and watershed resources. Increased residue may also address the needs of wildlife, fisheries, and aesthetics. While traditional utilization measurements are aimed entirely at key species, residue methods may measure key species or the total standing crop, regardless of species.

Residue methods are simple, quick, and accurate. These methods can be used to monitor large areas in less time than with traditional utilization methods. Statistical reliability improves because numerous measurements can be taken in a relatively short time. Limitations of these methods may stem from infrequent application in a variety of rangeland ecosystems. While residue methods have been very successful on the Great Plains, there needs to be more research on the use of residue methods in a variety of plant communities and ecosystems in the National Forest System.

Testing these methods is strongly encouraged due to the potential advantages. These methods are easily learned and can be applied by permittees and other interested groups and individuals. Residue sampling methods approved for use in the Rocky Mountain Region include: stubble height (Exhibit SH), herbage left ungrazed (Exhibit HU), and visual obstruction methods (Exhibit VO).

VEGETATIVE UTILIZATION

Utilization is expressed as a percentage of available forage weight[5] that has been consumed or trampled. Utilization estimates are in terms of the current year's biomass removed. Utilization measurements should be confined to forage species, not total herbaceous vegetation. Generally, only plants of selected key species are monitored. This does not preclude sampling other species if additional data is needed.

Utilization studies are conducted as often as necessary to satisfy data requirements for the allotment. Conduct utilization monitoring at various intervals throughout the grazing season as needed to adjust pasture rotations. Utilization is monitored annually until AMP objectives are achieved. Utilization monitoring requirements are unique to each allotment and should be focused on accomplishing allotment objectives.

Measure utilization soon after livestock are removed from the allotment or unit (not more than a week) to eliminate bias due to regrowth. This is especially important on bluegrass bottoms, riparian areas, and mountain meadows where regrowth occurs fairly rapidly. If utilization is used as a guide for moving livestock from one unit to another, utilization estimates should be made far enough in advance to insure movement at or prior to the desired use level. Timing of measurements is critical in furnishing the data needed to adjust permitted use or obtain improved distribution of livestock within the current season.

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[5] Weight is not evenly distributed in most plant species. A higher percentage of the weight is in the basal portion of the plant where growth is thicker and more dense. A lower percentage of the weight is in the upper portion of the plant where growth is tapered and less dense. Weight distribution in relation to height is reasonably constant among plants of the same species.

Plant regrowth occurs following an interruption of growth by grazing, fire, or other disturbance. Regrowth also occurs in response to favorable weather events following the normal growing season. When animals use the same area more than once a year and plant regrowth occurs, utilization is still based on the amount of available growth at the time the data are collected. Percent utilization after each use represents only the *amount of available growth* utilized up to the time the studies are conducted. Utilization percentages or stubble heights for various use periods during the grazing season cannot be summed to get total utilization for the year. For example, 30 percent utilization of 6 inches of plant growth available in the spring and 30 percent utilization of 12 inches of plant growth in the fall, do not add to 60 percent utilization for the year.

Monitoring browse utilization is an important aspect of rangeland management. It is important to know how much use occurs and which animals are using the browse. Use the ocular estimate method (Exhibits OEH, OEB, and OEA) for browse utilization estimates.

UTILIZATION MONITORING METHODS

Utilization monitoring methods approved for use in the Rocky Mountain Region are: utilization study (paired-plot) (Exhibit US), utilization gauge (Exhibit UG), and ocular estimates (Exhibits OEH, OEB, and OEA). No single method is preferable in all situations. Each has advantages and disadvantages that must be considered with respect to the area and purpose for which the study will be conducted.

OTHER UTILIZATION METHODS

Several methods for determining forage utilization are available, but are not discussed in this guide. This guide addresses only those methods deemed most appropriate for this Region. These methods are consistent with those contained in range analysis handbooks from other Regions and agencies. Other methods can be used if they are subjected to peer review, published in a scientific journal, and approved by the Regional Forester.

LONG-TERM TREND MONITORING

Probably the most important role of monitoring is to determine whether management is successful in moving rangeland resources towards the objectives (effectiveness monitoring). Determining trend toward or away from allotment objectives allows rangeland managers to accurately determine the relative success of the management system and to adjust management to speed the accomplishment of objectives. Trend for a variety of rangeland resource parameters may need to be monitored.

This guide describes accepted methods used to determine trend in vegetative and soil characteristics. Vegetative trend is based on such characteristics as species composition, density, cover, vigor, production, and frequency. Soil condition trend considers ground cover and erosion status. Trend data is considered along with actual use, authorized use, utilization, climatic cycles, and other resource activities and impacts, in designing and adjusting the management strategy. Permittees and other interested parties should be encouraged to become active partners in monitoring trend.

Early detection of trend involves some risks because vegetative characteristics naturally fluctuate widely within and between years due to climatic variability and other influences. These normal fluctuations must be considered when determining trend.

APPARENT VERSUS MEASURED TREND

Apparent trend is the interpretation of direction of change based on professional judgment during a single observation. Apparent trend results are highly subjective and depend to a great extent on observer experience. Apparent trend is useful in early detection of problems, and is a precursor to measured trend studies.

Measured trend is a quantitative assessment of change based on repeated measurements over time of the characteristics and amount of plant species, and soil surface properties. It provides quantitative data for interpreting change direction, often before it is detectable by repeated ocular examinations or repeated photos over time. Measured trend provides feedback to indicate whether management objectives are being attained. If progress is unsatisfactory (see page 3-13), modification in management practices is required.

FREQUENCY OF STUDIES

Trend studies are conducted as frequently as necessary to satisfy data requirements for the allotment or designated management area. They are generally conducted at intervals, in sequence with grazing treatments. For example, trend studies could be conducted once every three years on a three-pasture grazing system and once every five years on a five-pasture rotation system. Where studies are conducted only once during the grazing cycle, they should be conducted at the same relative point in each cycle so the data is comparable. Because limited resources often dictate trend monitoring be done infrequently, a monitoring strategy designed to aid in accurate identification of trends and their causes is important. Means to overcome infrequent measurement are described below.

1. Select a few sites for frequent measurement. Sites should be where collateral information relative to management objectives can be obtained. Continuous trend of soil and vegetation characteristics with respect to weather, utilization, actual use, and other variables on a few sites will support a more accurate interpretation of data gathered elsewhere on an infrequent basis.
2. If vegetation cover is declining at numerous sites, regardless of the management system, it may be presumed that weather or factors other than management are responsible. However, if cover of forage species declines on an ecological type in one management unit, but increases or is static on the same ecological type in an adjacent unit, a management change is warranted.

TIMING OF STUDIES

Trend studies should be started before initiating management under a new or revised allotment management plan to ensure the resource situation is documented prior to management changes. Trend data is normally collected after the growing season, when the majority of plants have reached their maximum growth. However, certain plant communities and environmental influences may require that photos be taken and measurements recorded at different times during the growing season. In order to obtain the best data, trend studies should be conducted on ungrazed pastures. It is important that once the time for trend studies is established, follow-up studies in succeeding years must be conducted at the same time (phenologically) during the growing season.

INTERPRETING TREND DATA

Changes in soil cover characteristics or in kind, proportion, or amount of plant species on a site are interpreted as trend in desired condition status (see page 3-10). To determine if a management change is needed to reverse undesirable, or to accelerate desirable trends, the causes of trends need to be established. Annual precipitation and growing conditions should be compared to the averages for the area. The following are guidelines for collection and interpretation of trend data.

INTERPRETING TREND AT ONE LOCATION

Differences in measurements obtained because of sampling error, personal bias, or lack of adequate training should be minimized. The location and size of the sample area must be adequately determined and specified. The sample area should not involve more than one ecological type and sampling design should account for heterogeneity in plant pattern, topography, and micro climate.

INTERPRETING TREND IN A MANAGEMENT UNIT

It is rarely feasible, nor is it necessary, to obtain a statistically valid sample of an entire management unit for trend monitoring purposes. Each monitoring location should be carefully selected with specified objectives developed. Data from different sample locations should not be combined until after interpretation of each location is made, and then, only if it is certain no information will be lost. Overall trend on a management unit cannot be determined by averaging trend data from various locations except perhaps where the various locations are ecologically similar.

COLLATERAL DATA

Collection of collateral data to aid interpretation of soil or vegetation change is essential.

- Weather data should be collected on or near each monitoring location. National Weather Service or Forest Service storage gauges read monthly or seasonally can be used for precipitation. Max-min thermometers at selected locations may help explain extreme events. The years that trend measurements are made should be compared with averages for the area.

- Records of actual livestock and wildlife use should be maintained.
- Utilization should be measured on each monitoring location whenever and wherever trend data is collected and at other times when appropriate and feasible. Any residue or utilization method described in this chapter can be used.
- Document observations on populations or occurrence of rabbits, rodents, insects, fire, or other disturbances.

COMPLETED TREND STUDY REQUIREMENTS

A trend study must be properly planned, implemented, analyzed, and documented. Components of a trend study are described below.

PROPER PLANNING

The allotment management plan should have a monitoring section describing how allotment objectives will be monitored. The monitoring section will describe which trend method is most appropriate for the particular allotment, who will perform the trend monitoring, and when monitoring will be accomplished.

PROPERLY COLLECTED FIELD DATA

Field data should be collected utilizing accepted methods. Instructions should be taken to the field to insure consistency with regional standards and between different observers. Key areas and benchmarks should be established and identified on aerial photos and allotment maps. All data forms should be completed and summarized in the field. Photos should be taken and labeled for easy reference.

PROPER DOCUMENTATION

Trend monitoring is not complete until the data is properly analyzed and conclusions made. Perhaps the most important aspect of trend monitoring is to summarize the data in a clear and useful package so that resource managers can make reasonable management decisions based upon the information. All trend data, summary sheets, pinpricked aerial photos, descriptions of study areas, mounted photographs, and narrative information should be compiled, summarized, and placed in the files. The folder should be marked "Permanent Record, Do Not Destroy." Two complete sets of the study should be made: one set for the District files, and the second set for the Supervisor's Office.

SELECTING A METHOD

No single method of vegetation sampling for trend determination is suitable for all vegetative types and management situations. Selecting a sound sampling method is critical to the success of a study. Trend methods must be sensitive to changes in the plant community, and should be unbiased, efficient, and cost-effective. Carefully consider the advantages and limitations of each method with respect to the type of vegetation on which the studies are to be conducted, and the type of study needed to determine whether objectives are being met. Measurement of more than one vegetation or soil characteristic will provide a more complete picture of trend. A combination of methods should be used to yield more informative and reliable data when appropriate.

PERMANENT VERSUS TEMPORARY SAMPLES

One of the most important decisions regarding trend studies is the permanence of the sample. Permanent samples should be located on benchmarks representing the entire site. Temporary samples should be installed within well-defined key areas shown on the allotment map. Following are guidelines to consider when locating trend transects.

- A mix of both permanent and temporary samples is recommended for allotments where trend information is needed. Long-term trend studies using permanent transects provide the most reliable data.
- Temporary samples are quickly installed and read. Several temporary samples can often be measured in the same amount of time required to locate and read one permanent transect. Temporary samples are located randomly within a key area and should be established using the same methodology as permanent samples, except that no stakes or permanent markers are used. Temporary samples are not paced transects, since a tape is *always* used and data is read along the tape. Using the tape greatly eliminates bias inherent with paced transects.
- Permanent samples should be established with permanently marked beginning and ending points. The samples should be marked so they are easily relocated. Inventory crews should use Global Positioning System (GPS) technology to locate and relocate permanent samples. Rangeland managers must make every effort to get training and use GPS technology where possible. Photos attached to the permanent samples should clearly indicate significant changes in vegetation.

TREND DETERMINATION METHODS

There are several methods for determining trend of vegetative and soil characteristics. Approved methods include: cover-frequency transect (Exhibit CF), line intercept and shrub density (Exhibit LI), and rooted nested frequency (Exhibit RN).

GRAZING CAPACITY DETERMINATION

Resource conditions on some allotments are not meeting, nor moving, towards Forest Plan objectives. These situations are identified through inventories of existing conditions and by reviewing past trend data. When these situations occur, rangeland managers should re-evaluate grazing capacity, that is, the amount of livestock use that can be allowed while meeting basic resource needs and associated allotment objectives. Since grazing capacity determinations can greatly affect permittees and local economies, it is essential that capacity estimates be made only after intensive study over several years.

PRODUCTION-UTILIZATION SURVEYS

Production-utilization (P-U) surveys are intensive, time-consuming, and require long-term commitment of time and funding. P-U studies are only recommended where reductions or increases in permitted use is obvious, and no other alternatives exist to bring resource conditions into compliance with allotment objectives. Studies should be conducted for at least three years on season-long allotments and for a full rotation on rest or deferred systems. The schedule should be sufficient to allow for vegetative production fluctuations due to climatic conditions. Accurate actual use records must be kept during study years. Production-utilization surveys are described in Exhibit PU.

FURTHER GRAZING CAPACITY CONSIDERATIONS

Production-utilization studies are only *one* factor in establishing grazing capacity. *As with any study, production-utilization can only be used as a guide to stocking.* Ultimately the true grazing capacity for an area will depend upon a variety of factors including: climate, type and breed of livestock, management system, permittee involvement, improvements, and many others. Trend towards objectives is the primary consideration used in adjusting stocking rates. Capacity estimates are not considered as static. Estimates shall be periodically reviewed and adjusted to bring them in line with changing conditions. Stocking rates must allow a safety margin to provide for low forage producing years. The quality of management and system of use also has a marked effect on grazing capacity.

EXHIBIT SH: STUBBLE HEIGHT

R2-2200-SH

GENERAL DISCUSSION

Stubble height, or inches of herbage left ungrazed, is becoming a well-accepted method of expressing desired rangeland use. Stubble height guidelines are most appropriate in riparian areas and for riparian vegetation, primarily *Carex* species. Development of stubble height guidelines and further refinement of this method is strongly encouraged.

Adequate stubble height on streamside areas is needed at the end of the grazing period or at the end of the grazing season, for maintenance of plant vigor and stream bank protection and to aid in holding sediments for rebuilding degraded stream banks. At a minimum, stubble height measurements should be made along the green line (see page 5-21) of key riparian complexes that reflect effects of current management systems.

TRAINING

This method requires measuring stubble heights of selected key species. Training is minimal. Measuring stubble height can be done by Forest Service personnel, permittees, or non-technical individuals.

PERSONNEL AND EQUIPMENT

This method can be done by one, or preferably two, individuals. Equipment needed includes a tape measure and the Stubble Height Form (R2-2200-SH).

SAMPLING PROCEDURE

Examiners identify plant species both before and after they are grazed, and understand the green line concept in riparian monitoring. Measurements need to be made on key riparian areas cooperatively identified by users and interdisciplinary teams. The Riparian Ecosystems Chapter is devoted entirely to inventory and monitoring techniques for riparian areas. Riparian plant species whose stubble height will be monitored and measured should also be cooperatively agreed upon. Normally, several plant species need to be monitored.

Stubble heights should be measured along both sides of the stream. When stubble heights are being measured in conjunction with the Green Line and Streambank Alteration Methods, all three methods should be completed along the same stream segment.

The stubble height transect is completed by taking 100 paces along the green line on both sides of the stream. At every second step, record the average stubble height (leaf length) of the key species nearest the toe of your right boot. This will result in 100 measurements (50 on each side of the stream). Using R2-2200-SH, calculate and record the average stubble height for each species and transect.

Through an interdisciplinary process, a preferred stubble height should be specified for key species within the riparian community complex. For example, a stubble height of 3-4 inches may be selected to maintain plant vigor, provide streambank protection, and trap sediments. Experience in the Rocky Mountain Region indicates that a 4-inch stubble height on early use pastures, where some regrowth is expected, is generally adequate to accomplish riparian objectives. Increased stubble height guidelines, such as 6 inches or greater, may be needed in late use pastures, or to protect special values such as critical fish habitat or waterfowl nesting cover.

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STUBBLE HEIGHT (R2-2200-SH)

FOREST GM/UNC/GUNN NF | **DISTRICT** TAYLOR RIVER RD | **SPATIAL ID** FS 02 12 10 373010830 0045 94

ALLOTMENT NAME AND NUMBER EAST FORK | **PASTURE** WILLOW SPRING

KIND/CLASS & NUMBER OF ANIMALS 198 C/C | **PERIOD OF USE** 7/1 - 8/1 | **ACTUAL USE** 198 Animal Months

DATE 08/04/1994 | **EXAMINER(S)** MJB | **FEET/PACE** 2.6

Site (or) Species	1 DECE	2 CANE2	3 POPR	4
1	4	3	2	
2	7	5	3	
3	6	6	4	
4	8	4	2	
5	2	2	4	
6	5	1	4	
7	3	7	5	
8	6	4	3	
9	9	3	3	
10	4	3	5	
11	4	5	3	
12	3	6	6	
13	2	4	5	
14	5	2	4	
15	4	4	5	
16	2	4	5	
17	3	3	4	
18	6	6	2	
19	2	6	1	
20	7	8	5	
21	4	6	4	
22	5	2	4	
23	3	4	5	
24	6	3	4	
25	5	3	4	
26	3	5	3	
27	6	5	3	
28	6	7	5	
29	2	6	4	
30	5	4	2	
31	3	2	2	
32	5	2	3	
33	6	4	2	
34	4	2	2	
35	4	3	1	
36	5	4	4	
37	5	3	1	
38	8	2	1	
39	10	2	3	
40	8	2	4	
41	4	2	3	
42	2	4	3	
43	7	3	2	
44	6	4	4	
45	5	3	5	
46	4	3	4	
47	4	4	3	
48	10	2	3	
49	10	2	2	
50	11	5	6	
Sub-Total	258	189	171	
Average				

Site (or) Species	1 DECE	2 CANE2	3 POPR	4
51	7	6	5	
52	7	4	4	
53	5	4	4	
54	6	7	3	
55	9	9	3	
56	9	6	2	
57	4	5	3	
58	4	3	5	
59	6	3	5	
60	7	2	5	
61	6	1	7	
62	5	2	7	
63	5	3	8	
64	10	3	3	
65	12	3	2	
66	12	5	1	
67	7	6	5	
68	9	2	6	
69	7	1	7	
70	7	7	9	
71	6	4	2	
72	7	4	2	
73	9	3	2	
74	10	3	3	
75	9	2	1	
76	9	2	3	
77	8	3	3	
78	8	2	2	
79	7	1	4	
80	6	1	4	
81	4	6	5	
82	4	3	4	
83	6	2	6	
84	9	4	3	
85	9	4	2	
86	11	3	2	
87	4	6	1	
88	12	5	4	
89	8	3	3	
90	7	2	2	
91	6	2	1	
92	5	1	6	
93	5	2	7	
94	7	3	7	
95	7	4	6	
96	9	5	5	
97	8	7	2	
98	7	5	1	
99	4	4	2	
100	3	2	3	
Total	616	369	363	
Average	6.2	3.7	3.6	

(Record averages on back of form)

Stubble Height Summary

Average stubble height for site or species 1	6.2
Average stubble height for site or species 2	3.7
Average stubble height for site or species 3	3.6
Average stubble height for site or species 4	
Σ for all sites or species	13.5
Average for all sites or species	4.5

EXHIBIT HU: HERBAGE LEFT UNGRAZED

R2-2200-HU

GENERAL DISCUSSION

To meet the needs for range forage perpetuation and improvement, soil cover for watershed protection, wildlife habitat, and others it may be desirable to measure the total amount of herbage (pounds/acre) that is left ungrazed. Forests and Districts should develop minimum and optimum standards for herbage left ungrazed for the local situation. Standards must not be arbitrary and should be based on scientific evidence that indicates the amount of herbage needed to achieve specific objectives (Bement, 1968).

TRAINING

The Herbage Left Ungrazed Method does not require intensive training. Examiners can develop their "eye" for accurate estimates with a small amount of experience.

PERSONNEL AND EQUIPMENT

With a small amount of training, an individual can work independent of others with little supervision. Grass clippers, a plot frame, paper sacks, spring scales (calibrated in grams), and a map of the allotment or area to be sampled is needed. Form R2-2200-HU is used to record herbage left ungrazed data.

SAMPLING PROCEDURE

The procedure for measuring herbage left ungrazed is described below.

1. Clip and weigh several (3-5 is usually adequate) random plots in each sample area to determine the pounds of forage left after grazing. A sample area is a small area with a uniform amount of herbage remaining. Estimates of herbage remaining are usually combined for all forage species. A variety of plot shapes and sizes can be used. Weigh forage to the nearest 5 grams and convert to pounds/acre using the conversion rates in Table HU–1. Estimates should be converted to air-dry weights using factors for converting green field weights to air-dry weights (Table PD-2).
2. Ocularly estimate herbage left ungrazed over the remainder of allotment, unit, or area based upon the clipping results in the sample area.
3. Transfer the herbage left ungrazed data to the allotment map, identifying zones or areas with similar amounts of herbage remaining.

Table HU-1. PRODUCTION CONVERSION FACTORS

Plot frame			Multiply grams weighed in order to determine:[1] lbs/ac	kg/ha
Rectangle:	20x50 cm.	(.1 m^2)	89.2	100.0
Square:	50x50 cm.	(.25 m^2)	35.7	40.0
Circle:	radius 6.6 in	(0.96 ft^2)[2]	100.0	112.9
Circle:	radius 21.0 in	(9.6 ft^2) [3]	10.0	11.2

---

[1] kg/ha x .9 = lbs/ac

[2] The 0.96 ft^2 circle can be constructed by using 41.7 inches of cable

[3] The 9.6 ft^2 circle can be constructed by using 131.8 inches of cable

HERBAGE LEFT UNGRAZED (R2-2200-HU)

FOREST GM/UNC/GUNN NF	**DISTRICT** TAYLOR RIVER RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER EAST FORK		**PASTURE** WILLOW SPRING
KIND/CLASS & NUMBER OF ANIMALS 198 C/C	**PERIOD OF USE** 7/1 - 8/1	**ACTUAL USE** 198 **Animal Months**
DATE 08/04/1994	**EXAMINER(S)** MJB	

Site (or) Species		**1**	**2**	**3**	**4**	**5**	**6**
		DECE	CANE2	POPR			
1	**GW**	2.1	1.1	0.9			
2	**GW**	1.4	0.9	1.1			
3	**GW**	1.8	1.6	0.5			
4	**GW**	1.2	2.2	1.9			
5	**GW**	1.9	1.3	1.8			
6	**GW**	2.7	3.1	1.4			
7	**GW**	1.0	1.1	0.6			
8	**GW**	0.4	0.9	0.6			
9	**GW**	1.1	0.7	1.0			
10	**GW**	1.7	1.4	0.9			
Average GW		15.3	14.3	10.7			
DW Factor		0.6	0.6	0.6			
Average DW		9.2	8.6	6.4			

EXHIBIT VO: VISUAL OBSTRUCTION

R2-2200-VO

GENERAL DISCUSSION

The Visual Obstruction Method is used primarily for determining standing biomass on an area. The method has been primarily used to determine the quality of nesting cover for birds on the Great Plains, and is commonly referred to as the Robel Pole Method. This method is applicable to other ecosystems where height and density of cover are important.

TRAINING

Anyone experienced with the Robel pole can train others in five minutes or less, provided the cover classes (Table VO-1) for the area have been established.

PERSONNEL AND EQUIPMENT

A Robel pole, aerial photographs or allotment map, cover classes for the area or community being sampled, and Form R2-2200-VO are needed for the examiners to complete the transects.

SAMPLING PROCEDURE

The sampling process is described below.

1. Determine proper residue guidelines. These guidelines should be developed during the allotment planning process and documented in the AMP. Height-density guidelines should be expressed in inches of desirable cover.
2. Establish cover classes for the area or plant community based upon resource objectives. Table VO-1 shows cover classes used on the Fort Pierre National Grassland for upland bird nesting cover. These cover classes are displayed only as an example. Cover classes must be developed locally and must address management objectives.
3. Delineate units of similar cover levels on aerial photos or the allotment map. These units of similar cover should be obvious to the observer. No attempt should be made to subdivide areas with complex utilization/cover patterns.
4. A minimum of two transects is needed for each unit; more may be necessary to provide greater accuracy. Transect locations are randomly selected using a grid with 0.25 mile coordinates and are perpendicular to the predominate slope. Twenty-five stations of the visual obstruction (Robel) pole are located along the transect, every 10 paces (20 steps).

   A diagram of the pole and instructions on how to construct it is shown in Figure VO-1. Two height-density (H-D) measurements are taken at each station from opposite directions along the contour. The last 1-inch band totally or partially visible is recorded as the H-D, and the average H-D for the transect (n=25) is calculated.
5. Record the average H-D for each cover unit on the photo or allotment map. Form R2-2200-VO is used to record HD data.

Table VO-1. UPLAND BIRD NESTING COVER CLASSES, FORT PIERRE NATIONAL GRASSLAND

COVER CLASS	AVERAGE HEIGHT-DENSITY
Sparse	0.0-1.9
Light	2.0-2.9
Moderate	3.0-3.9
Heavy	4.0 +

In studies using this method, visual obstruction measurements can also be correlated to the weight of vegetation.[1] The relationship of H-D to biomass can be easily determined by clipping about twenty 20x50 cm rectangular (or similar size) plots centered on the pole reading location. The numbers can be plotted on graph paper.

The plots should be deliberately selected to cover the range of vegetation on a site. These relationships appear to be specific to given types of sites and/or vegetation types. A line that best fits the data plot is drawn in or can be calculated using linear regression techniques.

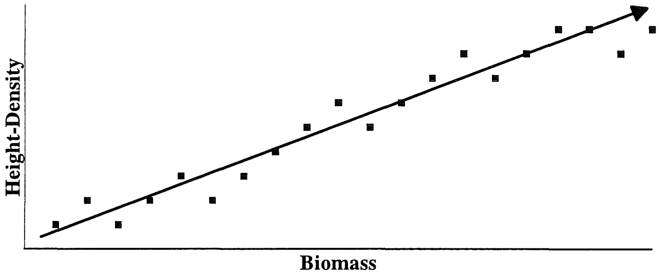
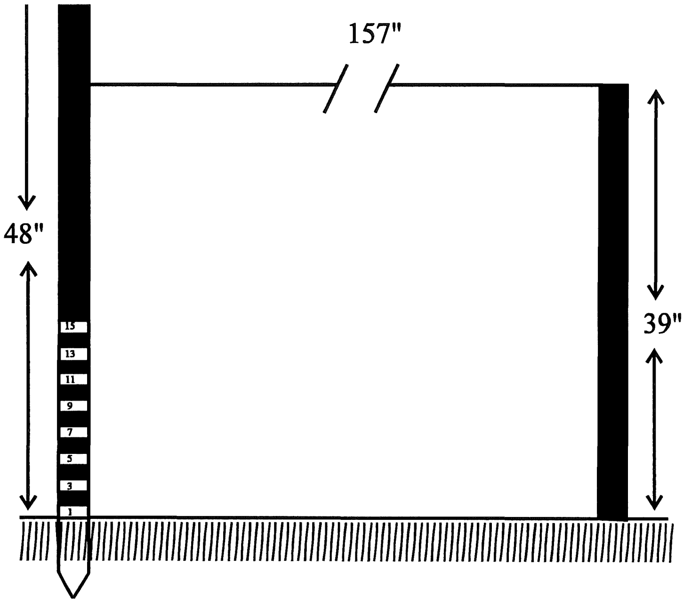


Figure VO-1. ROBEL POLE



1. Pole is 1.125 inch diameter and 48 inch long.
2. Pole is painted with alternating 1-inch bands of flat white and gray colors, starting with white on the bottom.
3. A single 157 inch (4 m) cord is attached to the pole at a height of 39 inch (1 m) to standardize the distance and height that readings are taken.
4. Narrow black numbers corresponding to the number of bands are painted on the white bands. For example, the bottom white band is "1", the next white band is "3", and so on.

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[1] Journal of Range Management, 1970, Volume 23, page 295

VISUAL OBSTRUCTION METHOD -- (ROBEL POLE)
(R2-2200-VO)

FOREST GM/UNC/GUNN NF	**DISTRICT** TAYLOR RIVER RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER EAST FORK		**PASTURE** WILLOW SPRING
KIND/CLASS & NUMBER OF ANIMALS 198 C/C	**PERIOD OF USE** 7/1 - 8/1	**ACTUAL USE** 198 **Animal Months**
DATE 08/04/1994	**EXAMINER(S)** MJB	

Sampling Interval = 10 paces

Transect	**# -** 1		**# -**		**# -**		**# -**	
Station	**H-D**	**H-D**	**H-D**	**H-D**	**H-D**	**H-D**	**H-D**	**H-D**
1	1	3						
2	2	4						
3	1	1						
4	2	1						
5	3	1						
6	1	2						
7	3	4						
8	3	3						
9	4	4						
10	1	2						
11	2	3						
12	1	1						
13	2	1						
14	3	2						
15	2	3						
16	1	2						
17	2	2						
18	3	3						
19	2	4						
20	3	3						
21	3	2						
22	1	3						
23	2	2						
24	3	1						
25	2	2						
Total	53	59						
Grand Total	112							
Average	2.24							

Other Observations:

EXHIBIT US: UTILIZATION STUDY (PAIRED-PLOT)

R2-2200-US

GENERAL DISCUSSION

Forage from protected and unprotected plots is clipped and weighed at the end of the foraging period. The difference represents the amount of forage consumed or trampled by grazing animals during that period. This method is suitable for all vegetative growth forms for which production and utilization data are commonly desired. It is particularly applicable where periods of use are short, utilization relatively uniform, and regrowth after foraging is not significant.

ADVANTAGES AND LIMITATIONS

The method is a simple and direct way of measuring forage utilization. Minor training is required and accuracy is generally high. The chief limitations are that it is time-consuming and that an area must be protected from grazing for comparison. There is evidence that in some instances the cage influences the micro climate so that vegetative growth and vigor are slightly different inside the cage. Also, where periods of use are long, the method does not provide information about the cumulative production of grazed plants unless the cages are moved at short time intervals.

TRAINING

The Paired-Plot Method does not require intensive training for field applications. Examiners must be able to identify plant species. Examiners can clip and weigh after only a short training period.

PERSONNEL AND EQUIPMENT

The Paired-Plot Method is time consuming since it requires the construction and placement of cages within the allotment. Appendix F contains diagrams and instructions for constructing several types of cages. Equipment required includes: cages, stakes for securing the cages, hammer for pounding stakes, grass clippers, paper sacks, spring scale (calibrated in grams), and Data Form (R2-2200-US).

SAMPLING PROCEDURE

Locate paired plots within key area(s). Mark the location of the plots so they can be relocated. Document the location of the study on allotment maps and maintain in the 2210 files.

1. Plant composition (species, cover, and growth) must be similar in both plots. Each plot must contain the key species.
2. Clipping plants has a marked influence on their physiological activities and the ecology of the site. Protected and clipped plots should be moved after use, and new plots selected for continuing study.

NUMBER OF PLOTS

Establish at least three sets of paired plots (three protected and three unprotected) in each key area selected for study. Three plots are a minimum, more should be established as needed.

PROTECTED PLOTS

Protect one plot of each pair from foraging. Flip a coin to decide which plot to protect. Anchor a cage over one of the paired plots at each plot location. The cage should be large enough to provide at least a 6-inch buffer zone between the edge of the plot and the side of the cage. The lower 1-2 feet of the cage may be covered with wire netting small enough to exclude rabbits and rodents. Generally, the larger the mesh, the less influence the cage has in modifying the environment. Cages should be placed just before grazing and never set in a new location the summer or fall before the next growing season. Temporary exclosures, such as those constructed with electric fence, may serve as protected plots instead of cages.

UNPROTECTED PLOTS

Leave one plot of each pair open to foraging. If past experience shows that foraging is particularly uneven, leave two or more plots open for each one caged in order to average the data. Animals are attracted to cages and may trample unprotected plots if located too close to protected plots. Therefore, establish unprotected plots a minimum of 100 feet from protected plots. Unprotected plots should be inconspicuously marked to avoid attracting animals.

SAMPLING

After examiners are trained, proceed with the collection of utilization data.

1. Clip current year's growth on key species from protected and unprotected plots.
2. On herbaceous species, clip all current year's growth to ground level.
3. Put the clippings from the protected and unprotected plots in separate paper sacks for weighing. Be sure to label the sacks.
4. Weigh the clipped plants and record separately the weight from the protected and unprotected plots on the Utilization Study Data — Paired Plot Method Form (R2-2200-US). Subtract the weight of the sack before recording the weights of the plants.

PERCENT UTILIZATION

Calculate the percent utilization as follows:

$$\%\ \text{Utilization} = \frac{\text{Total Protected Weight - Total Unprotected Weight}}{\text{Total Protected Weight}} \times 100$$

UTILIZATION STUDY DATA -- PAIRED PLOT METHOD
(R2-2200-US)

FOREST GM/UNC/GUNN NF	**DISTRICT** BUFFALO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER TABLE MESA		**PASTURE** BEEF
KIND/CLASS & NUMBER OF ANIMALS 90 C/C	**PERIOD OF USE** 8/1 - 8/15	**ACTUAL USE** 45 **Animal Months**
DATE 08/17/1994	**EXAMINER(S)** J. DAWKINS	

Plot frame			Multiply grams weighed in order to determine:[1] lbs/ac	kg/ha
Rectangle:	20x50 cm.	(.1 m^2)	89.2	100.0
Square:	50x50 cm.	(.25 m^2)	35.7	40.0
Circle:	radius 6.6 in	(0.96 ft^2)[2]	100.0	112.9
Circle:	radius 21.0 in	(9.6 ft^2)[3]	10.0	11.2

Key Species	Plot	Weight in Grams by Plot 1	2	3	4	5	Total Weight[4]	Weight Difference (P-U)	Percent Utilized (((P-U)/P)*100)
1	P[5]	6	8	4	6	3	27		
FEID	U[6]	3	5	4	4	1	17	10	37%
2	P	5	3	4	2	1	15		
STLE4	U	3	1	2	2	1	9	6	40%
3	P	7	6	3	6	5	27		
POPR	U	3	4	2	2	2	13	14	52%
4	P								
	U								
5	P								
	U								
6	P								
	U								
7	P								
	U								
8	P								
	U								
9	P								
	U								
10	P								
	U								

---

[1] kg/ha x .9 = lbs/ac

[2] The 0.96 ft^2 circle can be constructed by using 41.7 inches of cable

[3] The 9.6 ft^2 circle can be constructed by using 131.8 inches of cable

[4] Minus weight of the sack

[5] Protected plots

[6] Unprotected plots

LOCATION OF PAIRED PLOT 1	LOBO SPRING
LOCATION OF PAIRED PLOT 2	PINE MEADOW -- NW
LOCATION OF PAIRED PLOT 3	TABLE MESA
LOCATION OF PAIRED PLOT 4	TABLE MESA
LOCATION OF PAIRED PLOT 5	TABLE MESA
NOTES (USE COMMENTS FORM, IF NECESSARY)	

EXHIBIT UG: UTILIZATION GAUGE

R2-2200-UG

GENERAL DISCUSSION

This method is essentially the height/weight method used in the past except that many pages of standard height/weight curves in past handbooks have been consolidated into a compact gauge (Figure UG-1) that can be easily taken to the field. Utilization curves developed by the Rocky Mountain Forest and Range Experiment Station (Figure UG-2 and Figure UG-3) can be used if they adequately estimate utilization for individual species in your area, or field units can develop their own utilization curves for more localized accuracy.

ADVANTAGES AND LIMITATIONS

This method measures heights of grazed and ungrazed plants in a key area. Large areas can be sampled rather quickly. Limitations occur primarily through using the standard height/weight scales included with the gauge. Standard scales do not accurately reflect utilization in all areas. Users must test their results against paired-plot method results to ensure standard scales are accurate for their area. Develop local scales to increase utilization gauge accuracy, however this can be time-consuming.

TRAINING

The utilization gauge does not require intensive training for field application. Examiners must identify plant species and be able to use the gauge. Examiners must also be able to use another utilization method to verify that the results collected from the gauge are accurate and representative of the area. If results are not accurate, the examiner must note the inconsistency and suggest the creation of local utilization scales to use with the gauge.

PERSONNEL AND EQUIPMENT

One person can accomplish this method with: the gauge (Figures UG–1, UG–2, and UG–3) and appropriate species scales, measuring tape, and Data Form (R2-2200-UG).

SAMPLING PROCEDURE

1. At predetermined intervals along a transect or course, select the individual plant of the key species (except seedlings) nearest the toe and measure its height to the nearest 1/2 inch. Measure 100 plants and record each as "Grazed" or "Ungrazed." If necessary, measure additional plants off the transect to ensure a minimum of 30 ungrazed plants are measured.

   For seed-stalk-producing (culm) plants, measure tallest seed-stalk to nearest 1 inch; for non seed-stalk-producing (culmless) plants, measure the tallest leaf heights to 0.50 inch. Of the 100 plants, either measure all leaf lengths or measure all seed stalks. Do not mix leaf length and seed stalk measurements in the same transect.

2. Compute an average "ungrazed" height by totaling height of all ungrazed plants and dividing by the number of ungrazed plants measured.

3. Compute an average "grazed" height by totaling the heights of all plants measured on the transect (grazed and ungrazed) and dividing by the total number of plants measured on the transect. The intent is to only use plants measured along the transect for estimating grazed heights. Do not include heights of ungrazed plants off the transect in the calculation.

4. Pull slide out of envelope until scale for species concerned appears in window.
5. Turn dial until average "Ungrazed" height appears opposite arrow so designated.
6. Find "Grazed" heights in #3 on dial and on slide read percent utilization by species.
7. Repeat operation for each key species. Total the utilization percentages for key species and divide by the total number of species to get an overall utilization estimate.

PREPARATION OF UTILIZATION CURVES (SCALES)

Height-weight curves developed for the Rocky Mountain Region were used in developing the utilization scales used in the gauge. If utilization estimates using the gauge do not match clipping measurements, then local utilization curves and scales must be developed. A procedure for training, checking personal judgment, and promoting uniformity between examiners, as well as for determining percent utilization follows.

DEVELOP HEIGHT-WEIGHT CURVES

Develop height-weight curves by collecting plants of a given species and determining the height-weight relationship for that species. The curve for any given species must be checked for variation between different rangeland areas and precipitation zones. It is necessary to develop separate curves for species with both culm-producing and culmless plants.

SAMPLE PLANTS

Sample at least thirty plants of each species. Select only plants that have reached maximum growth.

1. At each interval along a paced transect, choose the ungrazed plant of the given species nearest the toe. Use one square inch as a unit area for sod-forming species and a comparable number of stems as a unit area for single stem species.
2. Remove all old leaves and stems of previous year's growth.
3. Clip the plant to within 0.25 inch of the ground.
4. Wrap the clipped plant loosely with thread from base to top to retain all leaves and culms in their natural position.
5. Separate the plants with culms from culmless plants and consider each separately.
6. Measure height of clipped plants to the nearest inch and determine average height.
7. Sample additional plants, if necessary.
8. Clip the top 10 percent by height of each plant and place the clippings in a paper bag labeled 0-10 percent. Clip additional height segments in 10 percent increments and place clippings in appropriately labeled bags: 11-20 percent, 21-30 percent, and so on. Use a large paper trimmer with a guide to hold the plants in their proper position and clip the segments. Label the bags to show species, date, and location. Place a given height segment for all plants of a species collected in one paper bag.
9. Dry the clippings in the paper sacks.

DETERMINE HEIGHT-WEIGHT RELATIONSHIPS

1. Weigh and record weights for each segment to the nearest tenth of a gram. Subtract sack weight before recording the dry weights of each height segment.
2. Total the dry weights for the segments. Record the total for the collected plants.
3. Record the cumulative weight for each segment, including the segment weight plus the weights of all preceding segments starting from the top of the plant.
4. Calculate the cumulative percent weight removed at each segment by dividing the cumulative weight for each segment by the total weight and multiplying by 100.
5. Plot the cumulative percent height removed, against the cumulative percent weight removed on graph paper. The resulting curve portrays the height removed-weight removed relationship for the species.

TRANSFER DATA FROM CURVES TO SCALES

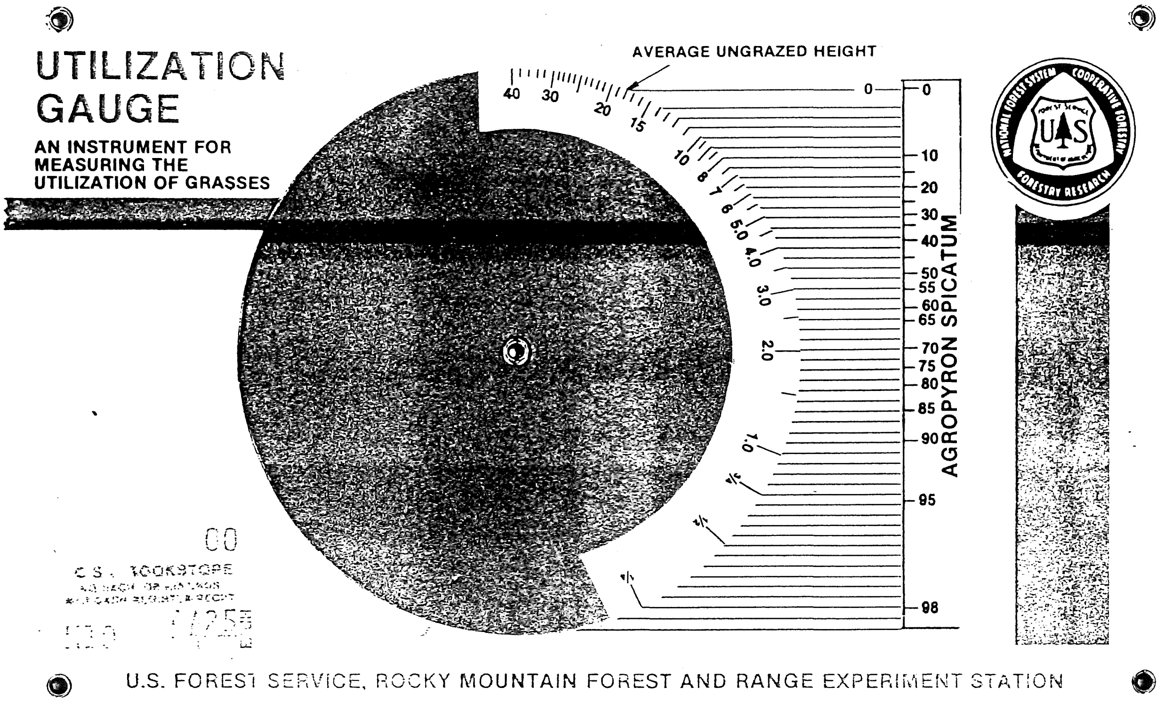
Transfer height-weight relationship data portrayed on the height-weight curve to a utilization scale for use in the utilization gauge.

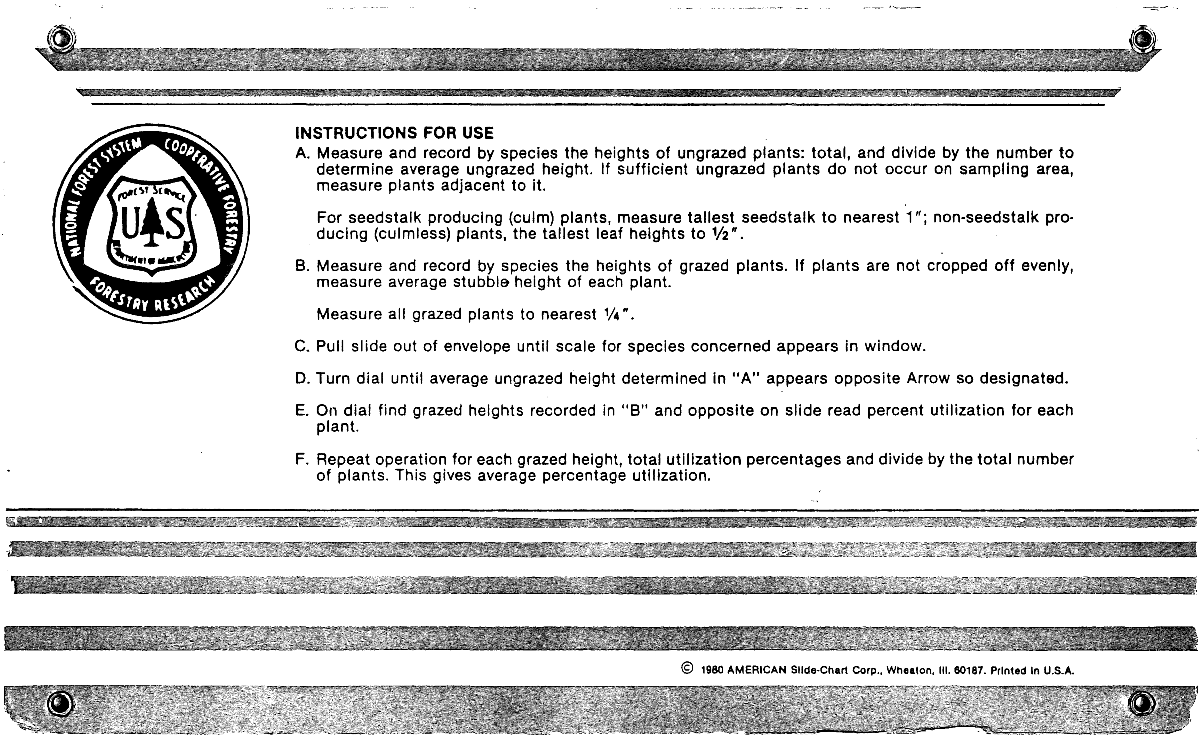
1. Turn the dial on the utilization gauge so that 10 inches is at the arrow designated "Average Ungrazed Height." With the dial set at 10, each one inch increment from 9 to 0 on the dial represents 10 percent of the height.
2. Slide a blank card into the utilization gauge.
3. Use the height-weight curve to determine the percent height that would be removed when 10 percent, 15 percent, through 95 to 98 percent of the weight is removed.
4. Enter 10 percent, 15 percent through 95 to 98 percent weight removed on the scale in the window of the utilization gauge across from the point on the dial representing the corresponding percent height removed. With the dial set at 10 inches for "Average Ungrazed Height," the percent removed can easily be converted to inches removed.

DOCUMENT SCALE PREPARATION

Maintain a record for each scale: of species, data used to prepare the scale, date the scale was prepared, and areas of applicability.

Figure UG-1. UTILIZATION GAUGE


UTILIZATION GAUGE
AN INSTRUMENT FOR MEASURING THE UTILIZATION OF GRASSES
AVERAGE UNGRAZED HEIGHT
40 30 20 15 10 8 7 6 5.0 4.0 3.0 2.0 1.0
0
0 10 20 30 40 50 55 60 65 70 75 80 85 90 95 98
AGROPYRON SPICATUM
U.S. FOREST SERVICE, ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION



INSTRUCTIONS FOR USE

A. Measure and record by species the heights of ungrazed plants: total, and divide by the number to determine average ungrazed height. If sufficient ungrazed plants do not occur on sampling area, measure plants adjacent to it.

For seedstalk producing (culm) plants, measure tallest seedstalk to nearest 1″; non-seedstalk producing (culmless) plants, the tallest leaf heights to ½″.

B. Measure and record by species the heights of grazed plants. If plants are not cropped off evenly, measure average stubble height of each plant.

Measure all grazed plants to nearest ¼″.

C. Pull slide out of envelope until scale for species concerned appears in window.

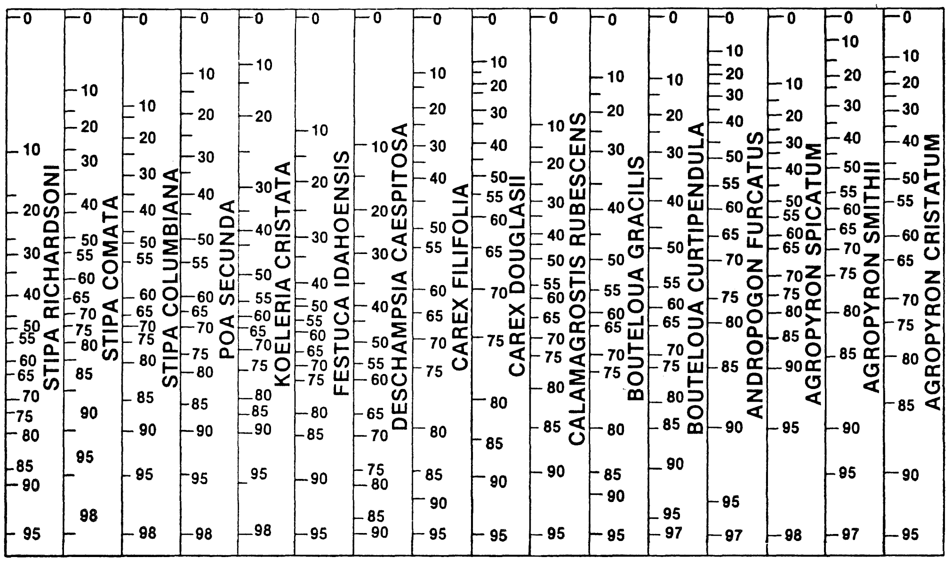
D. Turn dial until average ungrazed height determined in "A" appears opposite Arrow so designated.

E. On dial find grazed heights recorded in "B" and opposite on slide read percent utilization for each plant.

F. Repeat operation for each grazed height, total utilization percentages and divide by the total number of plants. This gives average percentage utilization.

© 1980 AMERICAN Slide-Chart Corp., Wheaton, Ill. 60187. Printed in U.S.A.

Figure UG-2. SPECIES SCALES (1)


STIPA RICHARDSONI
STIPA COMATA
STIPA COLUMBIANA
POA SECUNDA
KOELERIA CRISTATA
FESTUCA IDAHOENSIS
DESCHAMPSIA CAESPITOSA
CAREX FILIFOLIA
CAREX DOUGLASII
CALAMAGROSTIS RUBESCENS
BOUTELOUA GRACILIS
BOUTELOUA CURTIPENDULA
ANDROPOGON FURCATUS
AGROPYRON SPICATUM
AGROPYRON SMITHII
AGROPYRON CRISTATUM

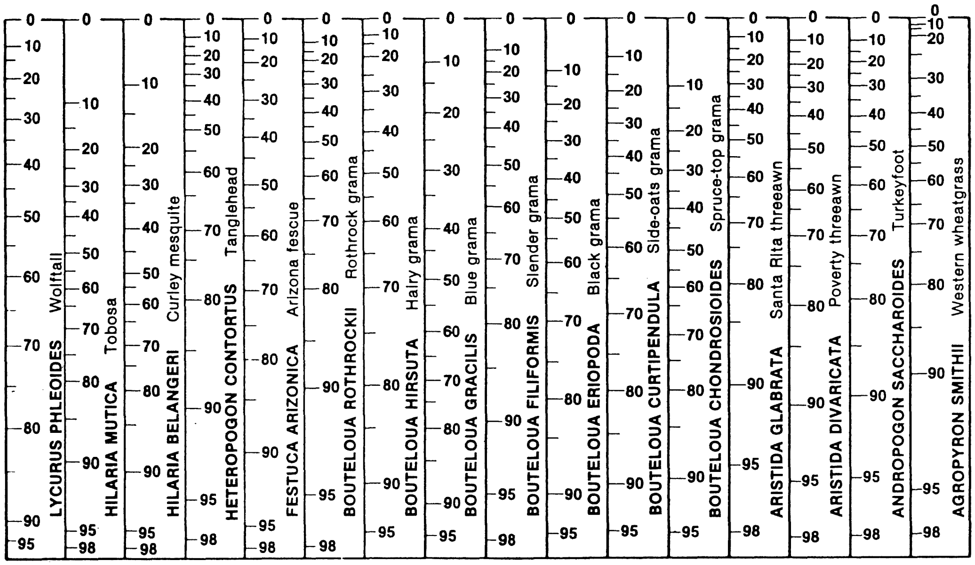
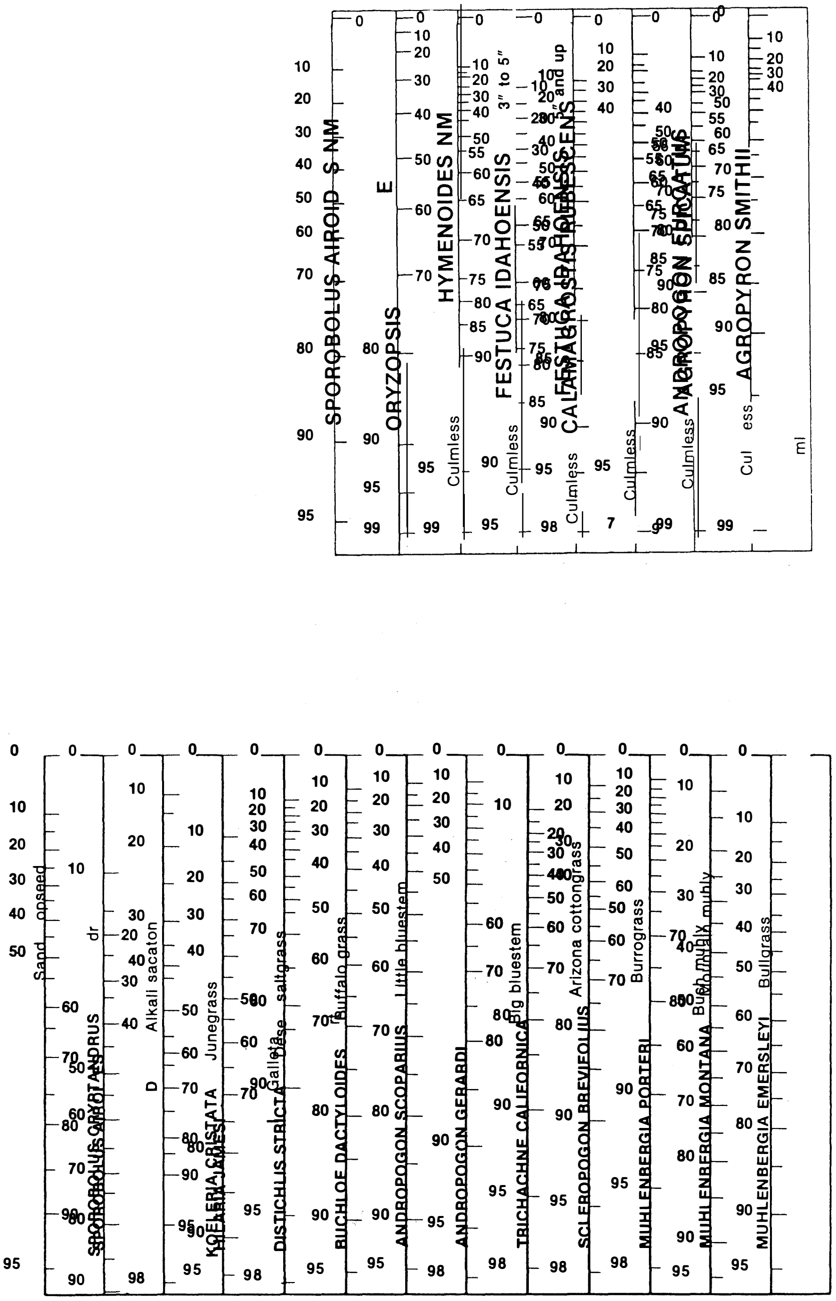

LYCURUS PHLEOIDES
Wolftail
HILARIA MUTICA
Tobosa
HILARIA BELANGERI
Curley mesquite
HETEROPOGON CONTORTUS
Tanglehead
FESTUCA ARIZONICA
Arizona fescue
BOUTELOUA ROTHROCKII
Rothrock grama
BOUTELOUA HIRSUTA
Hairy grama
BOUTELOUA GRACILIS
Blue grama
BOUTELOUA FILIFORMIS
Slender grama
BOUTELOUA ERIOPODA
Black grama
BOUTELOUA CURTIPENDULA
Side-oats grama
BOUTELOUA CHONDROSIOIDES
Spruce-top grama
ARISTIDA GLABRATA
Santa Rita threeawn
ARISTIDA DIVARICATA
Poverty threeawn
ANDROPOGON SACCHAROIDES
Turkeyfoot
AGROPYRON SMITHII
Western wheatgrass

Figure UG-3. SPECIES SCALES (2)


SPOROBOLUS AIROIDES NM
ORYZOPSIS
HYMENOIDES NM
FESTUCA IDAHOENSIS
3" to 5"
3" and up
FESTUCA IDAHOENSIS
CALAMAGROSTIS RUBESCENS
AGROPYRON SPICATUM
ANDROPOGON
AGROPYRON SMITHII
Culmless
SPOROBOLUS CRYPTANDRUS
Sand dropseed
SPOROBOLUS AIROIDES
Alkali sacaton
KOELERIA CRISTATA
Junegrass
HILARIA JAMESII
Galleta
DISTICHLIS STRICTA
Saltgrass
BUCHLOE DACTYLOIDES
Buffalo grass
ANDROPOGON SCOPARIUS
Little bluestem
ANDROPOGON GERARDI
Big bluestem
TRICHACHNE CALIFORNICA
SCLEROPOGON BREVIFOLIUS
Arizona cottongrass
Burrograss
MUHLENBERGIA PORTERI
Bush muhly
MUHLENBERGIA MONTANA
Mountain muhly
MUHLENBERGIA EMERSLEYI
Bullgrass

UTILIZATION GAUGE (R2-2200-UG)

FOREST BIGHORN NF | **DISTRICT** BUFFALO RD | **SPATIAL ID** FS 02 12 10 373010830 0045 94

ALLOTMENT NAME AND NUMBER TABLE MESA | **PASTURE** RED CREEK

KIND/CLASS & NUMBER OF ANIMALS 90 C/C | **PERIOD OF USE** 8/1 - 8/15 | **ACTUAL USE** 45 **ANIMAL MONTHS**

DATE 08/17/1994 | **EXAMINER(S)** J. DAWKINS

Key Spp	1. FEID		2. POPR		3.		4.		5.		6.	
	G	U	G	U	G	U	G	U	G	U	G	U
1	4	14										
2	3	10										
3	1	9										
4	5	11										
5	2	16										
6	5	12										
7	4	9										
8	2	10										
9	6	10										
10	1	9										
11	5	15										
12	4	14										
13	2	9										
14	1	12										
15	3	8										
16	2	13										
17	1	16										
18	3	11										
19	3	12										
20	3	11										
21	4	14										
22	1	17										
23	5	10										
24	1	8										
25	2	12										
26	2	16										
27	3	13										
28	2	15										
29	1	10										
30	4	13										
31	5											
32	1											
33	3											
34	2											
35	3											
36	4											
37	1											
38	1											
39	2											
40	3											
41	4											
42	5											
43	4											
44	3											
45	3											
46	1											
47	2											
48	2											
49	5											
50	2											

Key Spp	1. FEID		2. POPR		3.		4.		5.		6.	
	G	U	G	U	G	U	G	U	G	U	G	U
51	1											
52	1											
53	4											
54	5											
55	1											
56	1											
57	3											
58	3											
59	1											
60	1											
61	3											
62	2											
63	2											
64	1											
65	2											
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69	5											
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88												
89												
90												
91												
92												
93												
94												
95												
96												
97												
98												
99												
100												
Total Ave	186 5.5	359 12.0										
% Wt.	15%											

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[1] $Ht_{Grazed} = \frac{\sum Grazed + \sum Ungrazed}{100}$ and $Ht_{Ungrazed} = \frac{\sum Ungrazed + \sum Off\ Transect}{n_{Ungrazed} + n_{Off\ Transect}}$

EXHIBIT OE: OCULAR ESTIMATES

R2-2200-OEH, R2-2200-OEB, AND R2-2200-OEA

GENERAL DISCUSSION

These methods provide ocular estimates of woody forage utilization of upland herbaceous or browse species within one of six utilization classes. Observations are made on the appearance of the rangeland, especially key species, along a transect that traverses the key area.

ADVANTAGES AND LIMITATIONS

This method is adapted to upland areas where perennial grasses, forbs, and browse plants are key species and utilization data must be obtained using few examiners. This method is rapid and does not require ungrazed areas for training purposes. Estimates are based on a description representing a broad range (class) of utilization rather than a precise amount. Different examiners are more likely to estimate utilization in the same classes than they are to estimate the same actual utilization.

TRAINING

Personal judgment is involved in any estimation method. Estimates are only as good as the training and experience of the examiners. Training in the Paired-Plot Method (Exhibit US) will help examiners make the utilization class estimations. This method requires examiners be trained to:

- Identify the plant species.
- Recognize the six herbaceous or six browse utilization classes using the written class descriptions.
- Think in terms of the general appearance of the rangeland (slightly used, heavily used, *etc.*) at each observation point, rather than weight or height removed.

PERSONNEL AND EQUIPMENT

Ocular Estimate Forms (R2-2200-OEH, R2-2200-OEB, and R2-2200-OEA) are required; a tally counter is optional.

SAMPLING PROCEDURE

Select key area(s) and key species and determine the number, length, and location of the transects. Document location and other pertinent information concerning a transect on the form.

After examiners are trained and have confidence in their ability to judge utilization by class ("light", "heavy", etc.), proceed with data collection. At each observation point estimate the utilization class using the narrative description of the class. In those cases where part of a class description does not apply — for instance, percentage of seed stalks remaining — judge utilization based on those parts that do apply. An observation point is the immediate area containing the key species visible to examiners when standing at a particular location along the transect. Record the estimates by utilization class on the Ocular Estimate Forms: R2-2200-OEH (Key Herbaceous Species), R2-2200-OEB (Key Browse Species), and R2-2200-OEA (Key Aspen-Weed Community Species).

CALCULATING PERCENT UTILIZATION

Calculate the percent utilization as follows:

1. Total the number of observations for each utilization class.
2. Multiply the number of observations in each utilization class by the midpoints of the class intervals.
3. Total the products for all classes.
4. Divide the sum by the total number of observations on the transect.
5. Record the average percent utilization on the appropriate Ocular Estimate Form (R2-2200-OEH, R2-2200-OEB, or R2-2200-OEA).

HERBACEOUS UTILIZATION CLASSES

Six utilization classes are used to show relative degrees of use of key herbaceous species (grasses and forbs). Each class represents a numerical range of percent utilization. Estimate utilization within one of the six classes (Table OE-1).

Table OE-1. HERBACEOUS UTILIZATION CLASSES

CLASS	RANGE	MIDPOINT	DESCRIPTION
No Use	0-5 percent	2.5 percent	The rangeland shows no evidence of grazing use; or the rangeland has the appearance of negligible grazing
Slight	6-20 percent	13.0 percent	The rangeland has the appearance of very light grazing. The key herbaceous forage plants may be topped or slightly used. Current seed stalks and young plants of key herbaceous species are little disturbed.
Light	21-40 percent	30.0 percent	The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60-80 percent of the number of current seed stalks of key herbaceous plants remain intact. Most young plants are undamaged.
Moderate	41-60 percent	50.0 percent	The rangeland appears entirely covered as uniformly as natural features and facilities will allow. 15-25 percent of the number of current seed stalks of key herbaceous species remain intact. No more than 10 percent of the number of low value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)
Heavy	61-80 percent	70.0 percent	The rangeland has the appearance of complete use. Key herbaceous species are almost completely utilized with less than 10 percent of the current seed stalks remaining. Shoots of rhizomatous grasses are missing. More than 10 percent of the number of low value herbaceous forage plants have been utilized.
Severe	81-100 percent	90.0 percent	The rangeland has a mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seed stalks of key herbaceous species. Key herbaceous forage species are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.

BROWSE UTILIZATION CLASSES

Six utilization classes show relative degrees of use of available current year's growth (leaders) of key browse plants (shrubs, half shrubs, woody vines, and trees). Each class represents a numerical range of percent utilization. Estimate utilization within one of the six classes (Table OE-2).

Table OE-2. BROWSE UTILIZATION CLASSES

CLASS	RANGE	MIDPOINT	DESCRIPTION
No Use	0-5 percent	2.5 percent	Browse plants show no evidence of use; or browse plants have the appearance of negligible use.
Slight	6-20 percent	13.0 percent	Browse plants have the appearance of very light use. The available leaders of key browse plants have the appearance of very light use. The available leaders of key browse plants are little disturbed.
Light	21-40 percent	30.0 percent	There is obvious evidence of leader use. The available leaders appear cropped or browsed in patches and 60-80 percent of the available leader growth of the key browse plants remains intact.
Moderate	41-60 percent	50.0 percent	Browse plants appear rather uniformly utilized and 40-60 percent of the available leader growth of key browse plants remains intact.
Heavy	61-80 percent	70.0 percent	The use of the browse gives the appearance of complete use. The preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all available leaders are used and few terminal buds remain on key browse plants. Between 20-40 percent of the available leader growth of the key browse plants remains intact.
Severe	81-100 percent	90.0 percent	There are indications of repeated coverage. There is no evidence of terminal buds and usually less than 20 percent of available leader growth on the key browse plants remains intact. Some, and often much, of the second and third years' growth of the browse plants have been utilized. Hedging is readily apparent and the browse plants are more frequently broken.

ASPEN-WEED UTILIZATION CLASSES (USED BY SHEEP)

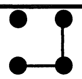
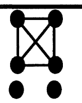
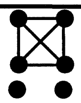
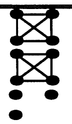
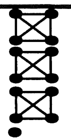
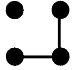
Six utilization classes (Table OE-3) are used to show relative degrees of use of key species (*Angelica*, *Ligusticum*, *Osmorhiza*, *Phleum*, *Polemonium*, *Trifolium*, and *Vicia*) and impacts to the vegetation (trailing and trampling) as the use occurs in the aspen-weed community.

Table OE-3. ASPEN-WEED UTILIZATION CLASSES

CLASS	RANGE	MIDPOINT	DESCRIPTION
No Use	0-5 percent	2.5 percent	The vegetation shows no evidence of grazing use; or the vegetation has the appearance of negligible grazing.
Slight	6-20 percent	13.0 percent	The vegetation has the appearance of very light grazing use. The key species may be topped or slightly used. Current seed stalks and young plants of the key species are little disturbed. There are no readily visible indications of trailing or trampling.
Light	21-40 percent	30.0 percent	The vegetation may be topped, skimmed, or grazed in patches. Plants not considered as key species are ungrazed and 60-80 percent of the number of current seed stalks of the key species remain intact. Most young plants are undamaged. Tall larkspur, aspen peavine, and senecio may be stripped of their leaves, but the stem is still standing. There may be occasional trails through the vegetation, but they are widely scattered. Small scattered patches of vegetation may be knocked down where sheep have bedded or bunched up during the day.
Moderate	41-60 percent	50.0 percent	The vegetation appears entirely covered as uniformly as natural features and facilities will allow. 15-25 percent of the number of current seed stalks of the key species remain intact. No more than 10 percent of the plants not considered as key species are utilized. Trails through the vegetation are frequently over the entire area and are easily observed. Patches of vegetation that have been knocked down are common throughout the area.
Heavy	61-80 percent	70.0 percent	The vegetation has the appearance of complete use. Key species are almost completely utilized with less than 10 percent of the current seed stalks remaining. More than 10 percent of the plants not considered as key species have been utilized. Trails overlap and cross each other so as to appear they cover almost the entire area. Sheep scat/dung is very common and readily visible.
Severe	81-100 percent	90.0 percent	The vegetation has a mown appearance. There is no evidence of reproduction or current seed stalks of the key species. They are completely utilized. The remaining vegetation is grazed to the soil surface. Trailing damage is extensive and indicated by large areas of soil disturbance/movement.

UTILIZATION STUDY DATA -- (R2-2200-OEH)
OCULAR ESTIMATE METHOD -- Key Herbaceous Species

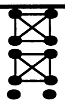
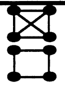
FOREST BIGHORN NF	**DISTRICT** BUFFALO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER TABLE MESA		**PASTURE** RED CREEK
KIND/CLASS & NUMBER OF ANIMALS 90 C/C	**PERIOD OF USE** 8/1 - 8/15	**ACTUAL USE** 45 **Animal Months**
DATE 08/17/1994	**EXAMINER(S)** J.DAWKINS	

Class Interval Midpoint	**Spp 1:** FEID Dot Count	Total (C)	(CxM)	**Spp 2:** FETH Dot Count	Total (C)	(CxM)	**Herbaceous Utilization Classes** (Browse utilization classes are on the other side)
No Use **0-5%** **M=2.5%**	● ● ●	3	7.5	● ● ●	3	7.5	Rangeland shows no evidence of grazing use; or rangeland has appearance of negligible grazing.
Slight **6-20%** **M=13%**		6	78	● ●	2	26	Rangeland has appearance of very light grazing. Key herbaceous forage plants may be topped or slightly used. Current seed stalks and young plants of key herbaceous species are little disturbed.
Light **21-40%** **M=30%**		12	360		12	360	Rangeland may be topped, skimmed, or grazed in patches. Low value herbaceous plants are ungrazed and 60-80% of the current seed stalks of key herbaceous species remain intact. Most young plants are undamaged.
Moderate **41-60%** **M=50%**		23	1150		31	1550	Rangeland appears entirely covered as uniformly as natural features and facilities will allow. 15-25% of the current seed stalks of key herbaceous species remain intact. No more than 10% of the low value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)
Heavy **61-80%** **M=70%**		6	420	● ●	2	140	Rangeland has appearance of complete use. Key herbaceous species are almost completely utilized with less than 10% of the current seed stalks remaining. Shoots of rhizomatous grasses are missing. More than 10% of the low value herbaceous forage plants have been utilized.
Severe **81-100%** **M=90%**							Rangeland has mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seed stalks of key herbaceous species. Key herbaceous forage species are completely utilized. Remaining stubble of preferred grasses is grazed to soil surface.
	Totals	50	2016	Totals	50	2084	
Average Utilization	$\frac{2016}{50} = 40\%$				$\frac{\quad}{\quad} =$		$\frac{\sum C\times M}{\sum C}$

Notes (use Comments Form, if necessary)

UTILIZATION STUDY DATA -- (R2-2200-OEB)
OCULAR ESTIMATE METHOD -- Key Browse Species

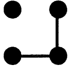
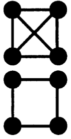
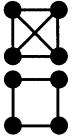
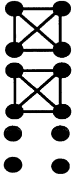
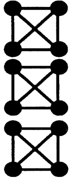
FOREST BIGHORN NF	**DISTRICT** BUFFALO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER TABLE MESA		**PASTURE** RED CREEK
KIND/CLASS & NUMBER OF ANIMALS 90 C/C	**PERIOD OF USE** 8/1 - 8/15	**ACTUAL USE** 45 **Animal Months**
DATE 08/17/1994	**EXAMINER(S)** J.DAWKINS	

Class	**Spp 1:** AMAL2			**Spp 2:**			**Browse Utilization Classes**
Interval Midpoint	Dot Count	Total (C)	(CxM)	Dot Count	Total (C)	(CxM)	(Herbaceous utilization classes are on the other side)
No Use **0-5%** **M=2.5%**	●	1	2.5				Browse plants show no evidence of use; or browse plants have appearance of negligible use.
Slight **6-20%** **M=13%**	● ● ●—●	5	65				Browse plants have appearance of very light use. Available leaders of key browse plants have appearance of very light use. Available leaders of key browse plants are little disturbed.
Light **21-40%** **M=30%**	● ● ● ●	4	120				There is obvious evidence of leader use. Available leaders appear cropped or browsed in patches and 60-80% of available leader growth of key browse plants remains intact.
Moderate **41-60%** **M=50%**		22	1100				Browse plants appear rather uniformly utilized and 40-60% of available leader growth of key browse plants remains intact.
Heavy **61-80%** **M=70%**		18	1260				Browse use gives the appearance of complete use. Preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all available leaders are used and few terminal buds remain on key browse plants. Between 20-40% of available leader growth of key browse plants remains intact.
Severe **81-100%** **M=90%**							There are indications of repeated coverage. There is no evidence of terminal buds and usually < 20% of available leader growth on key browse plants remains intact. Some, and often much, of the second and third years' growth of browse plants have been utilized. Hedging is readily apparent and browse plants are more frequently broken.
	Totals	50	2548	Totals			
Average Utilization		$\frac{2548}{50} = 51\%$			$\frac{\quad}{\quad} =$		$\frac{\sum C\times M}{\sum C}$

Notes (use Comments Form, if necessary)

UTILIZATION STUDY DATA -- (R2-2200-OEA)
OCULAR ESTIMATE METHOD -- Aspen-Weed Utilization

FOREST WHITE RIVER NF	**DISTRICT** BLANCO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER RIPPLE CREEK		**PASTURE** SWAN LAKE
KIND/CLASS & NUMBER OF ANIMALS 100 C/C	**PERIOD OF USE** 7/15 - 8/15	**ACTUAL USE** 100 **Animal Months**
DATE 08/20/1994	**EXAMINER(S)** B.COLE	

Class	**Spp 1:** Angelica			**Spp 1:** Osmorhiza			**Aspen-Weed Utilization Classes**
Interval Midpoint	Dot Count	Total (C)	(CxM)	Dot Count	Total (C)	(CxM)	
No Use **0-5%** **M=2.5%**							The vegetation shows no evidence of grazing use; or the vegetation has the appearance of negligible grazing.
Slight **6-20%** **M=13%**							The vegetation has the appearance of very light grazing use. The key species may be topped or slightly used. Current seed stalks and young plants of the key species are little disturbed. There are no readily visible indications of trailing or trampling.
Light **21-40%** **M=30%**		6	180	● ●	2	60	The vegetation may be topped, skimmed, or grazed in patches. Plants not considered as key species are ungrazed and 60-80% of the number of current seed stalks of the key species remain intact. Most young plants are undamaged. Tall larkspur, aspen peavine, and senecio may be stripped of their leaves, but the stem is still standing. There may be occasional trails through the vegetation, but they are widely scattered. Small scattered patches of vegetation may be knocked down where sheep have bedded or bunched up during the day.
Moderate **41-60%** **M=50%**		20	1000		18	900	The vegetation appears entirely covered as uniformly as natural features and facilities will allow. 15-25% of the number of current seed stalks of the key species remain intact. No more than 10% of the plants not considered as key species are utilized. Trails through the vegetation are frequently over the entire area and are easily observed. Patches of vegetation that have been knocked down are common throughout the area.
Heavy **61-80%** **M=70%**		24	1680		30	2100	The vegetation has the appearance of complete use. Key species are almost completely utilized with less than 10% of the current seed stalks remaining. More than 10% of the plants not considered as key species have been utilized. Trails overlap and cross each other so as to appear they cover almost the entire area. Sheep scat/dung is very common and readily visible.
Severe **81-100%** **M=90%**							The vegetation has a mown appearance. There is no evidence of reproduction or current seed stalks of the key species. They are completely utilized. The remaining vegetation is grazed to the soil surface. Trailing damage is extensive and indicated by large areas of soil disturbance/movement.
	Totals	50	2860	Totals	50	3060	
Average Utilization	$\frac{2860}{50} = 57\%$			$\frac{3060}{50} = 61\%$			$\frac{\sum C\times M}{\sum C}$

Notes (use Comments Form, if necessary)

EXHIBIT CF: COVER-FREQUENCY TRANSECT

R2-2200-CF

GENERAL DISCUSSION

Since the Cover-Frequency Transect Method is the standard method for rangeland inventory, it is also the standard for monitoring changes in canopy cover and frequency of herbaceous species. This method provides estimates of canopy cover by species, frequency, ground cover, and production by life form through replicated sampling of plot frame transects. This method is applicable to a wide variety of plant communities as long as the plants do not exceed waist height.

ADVANTAGES AND LIMITATIONS

This method is relatively simple and rapid to use. Canopy cover and frequency are widely used in vegetation classification throughout the western United States. With adequate training, repeatable results are usually obtained. A limitation of this method is that there can be changes in canopy cover of herbaceous species between years because of climatic conditions with no relationship to the effects of management.

Combining canopy cover and frequency helps overcome data variability due to climate. A cover-frequency index (cover x frequency by species) can be used to determine change in composition over time. When using the cover-frequency method for monitoring purposes, establish a minimum of three transects on the site.

SAMPLING PROCEDURE

A complete description, equipment needs, and instructions for the Cover-Frequency Transect can be found in Exhibit CF of the Inventory Chapter.

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EXHIBIT LI: LINE INTERCEPT
R2-2200-LI

GENERAL DISCUSSION

The Line Intercept Method consists of horizontal, linear measurements of plant intercepts along the course of a line (tape). It is used primarily for quantitative measurements of shrub canopy cover, and may be used to calibrate ocular estimates of shrub canopy cover. This method is ideally suited for semiarid bunchgrass-shrub or riparian-shrub communities. Changes in canopy cover of sagebrush, snowberry, serviceberry, or other shrubs are easily determined using this method.

ADVANTAGES AND LIMITATIONS

Line intercept is a fast, easy, and accurate method of monitoring canopy cover changes of shrub species. It is best suited where the plant limits are well defined. It is not well adapted, however, for single stemmed species, dense grassland situations, litter, or rock less then 1/2 inch in diameter.

SAMPLING PROCEDURE

A complete description, equipment needs, and instructions for line intercept can be found in Exhibit LI of the Inventory Chapter.

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EXHIBIT RN: ROOTED NESTED FREQUENCY

R2-2200-RN

GENERAL DISCUSSION

For monitoring trend, the Rooted Nested Frequency Method analyzes changes in frequency of individual species over time on a specific site. Desired plant communities are selected and documented during allotment management planning. Increases or decreases in frequency of the species within the plant community can be estimated with the Rooted Nested Frequency Method.

An increase in a species that is dominant in the desired plant community can be interpreted as desirable or trending "toward" the desired plant community (DPC), and a decrease in a dominant species can be considered trending "away from" DPC.

ADVANTAGES AND LIMITATIONS

Frequency sampling is an objective method that is simple to perform and easy to duplicate from year to year. The only decisions to be made are plant species identification, and whether or not the listed species occurs within the plot. This method encourages consistent, accurate observations while minimizing bias among different examiners. Rooted Nested Frequency is the most reliable method for determining long-term trend, but is probably the most time consuming.

Frequency data is collected in different sized plots with each placement of the nested frame. When a plant occurs within a plot, it also occurs in all successively larger plots. Frequency of occurrence for various sized plots can be analyzed, although frequency is recorded for only one size plot. This eliminates problems with comparing frequency data from different sized plots. Use of the nested plot configuration improves the chance of selecting a proper plot size for frequency sampling. Frequency data is not subject to substantial fluctuations with climate.

This method should only be used when the highest level analysis intensity is required (see Table 3-1).

Frequency determinations give a good indication of changes in the occurrence of individual species over time. Frequency does not, however, provide a good description of the vegetative characteristics of a plant community, or why the vegetation is changing. Characteristics like cover, density, and spatial arrangement cannot be determined through frequency measures. A combination of the Cover-Frequency Method and the Rooted Nested Frequency Method will best describe changes in the vegetation and soil components of a plant community.

PERSONNEL AND EQUIPMENT

Two examiners are required for Rooted Nested Frequency Method. It is best if one person does the observations and the other records them. Two 100-foot tapes are required: one for the baseline and the other to be moved from transect position to transect position. A rooted nested frequency frame, and a die for randomly determining the sampling scheme are required. Other equipment is the same as for cover-frequency transects (Exhibit CF).

SAMPLING PROCEDURE

Upon selecting the study site and/or finding the previously established benchmark, the location should be documented and any changes in reference points or status of the transect noted.

PHOTOGRAPHS

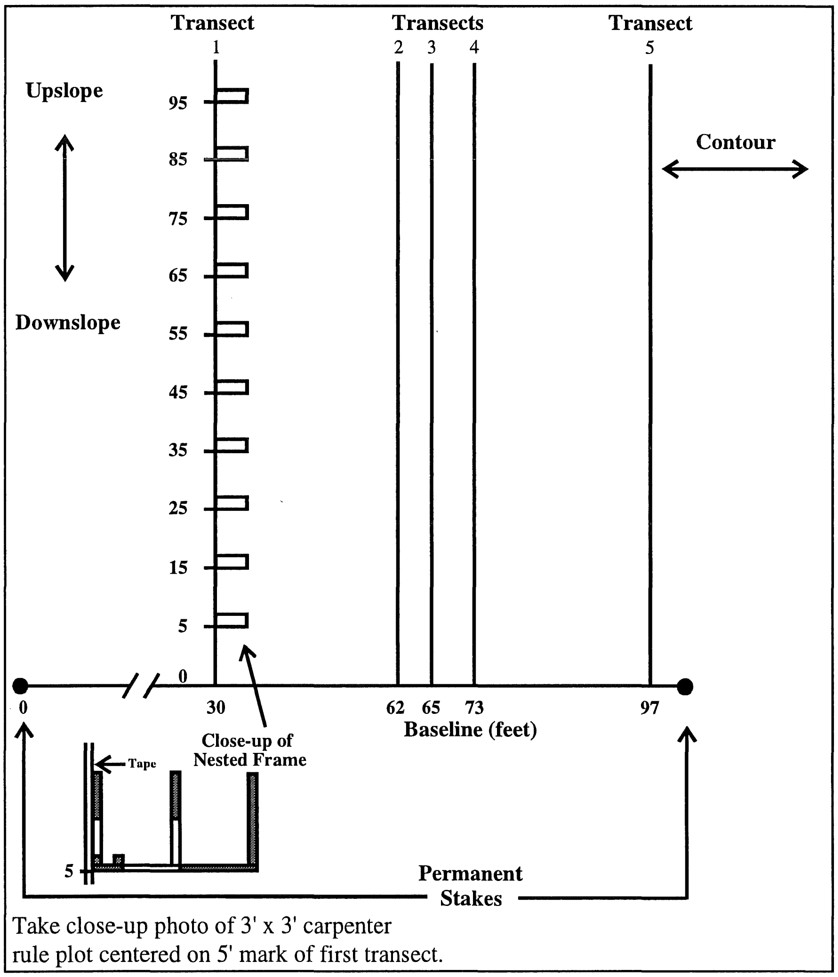
Photographs are an important part of the study and should portray changes taking place on the ground. They should provide a good visual image of the site and help relocate the study for future measurements.

As a minimum, a general view and a close-up photo of the 3 feet by 3 feet plot should be taken before taking any measurements. Photos should be taken from the 0.0 mark on transect 1 or at the best suitable point. Additional photos are encouraged.

SAMPLE DESIGN

The typical plot sampled in the Rooted Nested Frequency Method is a square measuring 100 x 100 feet. In some cases, due to a mosaic of vegetation types, this shape may be changed to ensure uniformity in the sampled vegetation community. The typical baseline for the transects is 100 feet long and is located perpendicular to the slope (on the slope contour) with the 0-foot mark on the left and the 100-foot mark on the right as the examiner faces upslope. Transects are placed perpendicular to the baseline (that is, parallel with the slope) and are sampled starting at the baseline (Figure RN-1). The baseline runs from west to east on flat areas with the 0-foot mark on the west end and the 100-foot mark on the east end. On flat areas, transects are located from the baseline to the north.

Figure RN-1. ROOTED NESTED FREQUENCY TRANSECT LAYOUT



Take close-up photo of 3' x 3' carpenter rule plot centered on 5' mark of first transect.

ESTABLISHING TRANSECTS

Locate transects within the plot perpendicular to the baseline and parallel with the slope. Since all rooted nested frequency plots are permanent, determine compass bearings of transects, and install angle iron or re-bar stakes at the transect starting points on the baseline. Five transects will be adequate for most sampling needs; however up to seven transects may be sampled if the variation warrants it.

Transect starting locations are determined by selecting the sampling scheme from Table RN-1. Use the roll of one six-sided die to determine which scheme to use. This determination can be done before leaving the office; that guarantees an unbiased selection, and it may keep the die from becoming lost. This table represents randomly generated sampling schemes for placement of 5-7 transects along the 100-foot baseline.

Do not use the same sampling scheme for every plot. This will avoid transects being placed in the same location along the baseline and creating a biased sampling system. Figure RN-1 depicts transect locations along a baseline using sampling scheme number 1.

COVER-FREQUENCY TRANSECT

> At least one cover-frequency transect should be done in conjunction with the rooted nested frequency transect, usually on the first rooted nested frequency transect.

NUMBER OF TRANSECTS

Begin this method by laying out and recording plant species data on five transects. To determine if five transects are adequate, calculate the cumulative number of new species, absolute number of new species, and the percent increase in new species for each transect. If the percent increase in new species recorded through the fifth transect is less than 25 percent for two consecutive transects, only five transects are required. If this condition is not met, seven transects are required.

An example demonstrating when five transects are adequate is shown in Table RN-2. Although this example shows a less than 25 percent increase for transects 3 and 4, there will *always* be at least five transects established for every rooted nested frequency plot.

NUMBER OF SAMPLES (FRAMES)

A minimum of 50 frames shall be sampled at each study site. Ten frames shall be measured along each transect at the 10-foot mark with the frame on the right side of the transect facing the 100-foot end. The small 5 cm x 5 cm plot should lie next to the beltline.

ROOTED NESTED FREQUENCY PLOT SIZE

The nested plot(s) in a frame refer to the size of the sampling units contained (nested) within the frame. Sampling of the vegetation is done with four plots of different sizes where the smaller plots are contained (nested) within a larger plot. The standard rooted nested frame for the Rocky Mountain Region is 50 x 50 cm. Plot size dimensions contained within that frame are in Table RN-3. Figure RN-2 illustrates the frequency frame.

Table RN-1. ROOTED NESTED FREQUENCY SAMPLING SCHEMES

Sample Scheme	Starting Location along Baseline (feet)[6]						
1	30	57	62	65	73	83	97
2	40	41	59	68	75	78	92
3	18	28	50	58	68	82	92
4	3	7	26	62	66	80	84
5	9	24	26	33	78	86	92
6	6	26	37	60	74	77	84

Table RN-2. DEMONSTRATION OF SAMPLING ADEQUACY

Transect Number	Cumulative Number of New Species	Absolute Number of New Species	Percent Increase in New Species
1	14	14	100
2	20	6	30
3	23	3	13
4	24	1	4
5	24	0	0

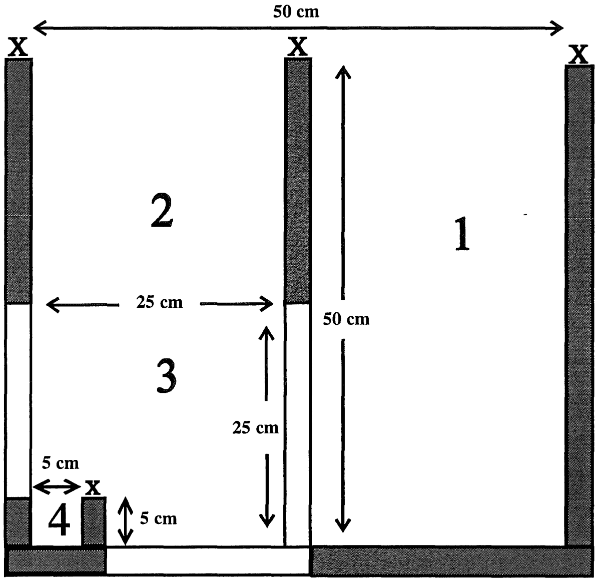
---

[6] Shaded numbers are for additional transects that will only be used when seven transects are needed.

Table RN-3. NESTED PLOT SIZES

Plot Number	Nested Plot Size
1	50 x 50 cm
2	25 x 50 cm
3	25 x 25 cm
4	5 x 5 cm

Figure RN-2. ROOTED NESTED FREQUENCY FRAME



Nested frequency frame is constructed from 0.5 inch PVC pipe. All dimensions are inside measurements. The "x" at the end of all four legs are the locations for ground cover measurements.

NUMERICAL IDENTIFICATION OF NESTED PLOTS

Since data is collected from all four plots within the frequency frame, individual plots within the frame need to be easily identified. The concept of nested plots can be best described as follows:

If Kentucky bluegrass is encountered in plot #4, it is automatically encountered in plots #1, #2, and #3 as well. This is true because plot #4 is a physical subset of all the other plots.

However, if the smallest plot Thurber fescue is found in is plot #2, then it is also in the larger plot (#1), but not in plots #3 and #4.

It is also important to understand that in this example, Kentucky blue grass (#4) does not occur twice as frequently as Thurber fescue (#2). The plot codes do not convey relative size. Conclusions from rooted nested frequency data can only be derived after the plot is resampled at a later time. Then the change in frequency *by an individual species* within the time interval between measurements can be determined.

PLACEMENT OF THE FRAME

Once a transect has been set up, the frame should be placed at the specified intervals along the transect.

The frame should be positioned so the open end of the frame is pointed towards the 100-foot end of the tape with the small plot (plot #4) next to the tape. Once the frame is placed on the foot-mark, it should not be moved during sampling to include or exclude species. Placing the frame at the specified interval ensures that samples are well distributed along the transects and avoids personal bias. This procedure should be followed until data have been collected from 10 frames along each of the five transects.

PRESENCE OR ABSENCE MEASUREMENTS

Only species rooted within the frame will be recognized. No effort will be made to count the number of individual plants. A plant is considered rooted within the plotframe if any portion of the root crown is contained therein. In case of mat-forming species, any portion of the crown extending into the plot will constitute presence of that plant. Reading and recording will be as follows:

1. Determine presence of *all species* contained within plot 4 (the smallest nested plot). Record their presence on the Nested Frequency Data form by placing a number 4 in the block for that particular sample along the transect.
2. Determine presence of any additional species in the next larger plot. Enter a number 3 for these species. Record a 3 only for species not encountered in the smaller plot (plot 4).
3. Determine the presence of any additional species in the third largest plot (plot 2). Enter a number 2 for those additional species encountered.

4. Record the presence of any other species in the largest plot (plot 1); place a number 1 only if additional species are encountered.
5. Record a blank or dash line on the form if the species of concern is missing on all plots for a particular frame.
6. The field portion of the form (R2-2200-RN) should be completed before proceeding to the next transect. This includes summarizing ground cover, and listing species missed in sampling.
7. In rereading monitoring areas that have special or limited objectives tied to 4 or 5 indicator species, the monitoring design could be limited to rereading only those species that are delineated for monitoring in the plan. Statistical analysis can be used on individual species for individual species trend determinations.

COMPUTATION OF FREQUENCY

The sum of rooted frequency is defined as the sum of the numbered plots for the ten nested plots along a sample transect. For example, the sum of rooted frequency for *Agropyron trachycaulum* along the following transect is 21:

Frame	1	2	3	4	5	6	7	8	9	10	Total
AGTR	1	3	2	4	2	2	2	1	2	2	21

This example only shows one transect. Frequency will be determined using all 50 frames (200 sample plots) on all five transects.

Data from all plots shall be used because change can be detected quicker using a rooted nested frequency plot (200 samples on five transects) rather than a single plot (50 samples on five transects).

SPECIES FOUND BUT NOT ENCOUNTERED IN PLOTS

Any species not encountered in individual plots but found growing along the transect should be listed at the bottom of the data sheet. These species, although not abundant, may be indicative of management emphasis needed or may be a key indicator species.

NESTED FREQUENCY DATA SUMMARY

Data collected from all five transects shall be summarized on R2-2200-RNSum.

GROUND COVER SAMPLE MEASUREMENT

Ground cover measurements can be easily obtained when reading rooted nested frequency transects. Record cover and bare soil data by noting the type of ground cover component present at the locations on the frequency frame shown in Figure RN-2. Take four ground cover measurements on each frame to yield 200 samples for the plot (4 samples/frame x 10 frames/transect x 5 transects = 200 samples/plot). Use a dot tally recording system to keep track of this information.

Acquire ground cover data for each plot frame as the transect is read. The purpose of collecting ground cover data is to describe the ground surface. Interpretations regarding soil surface protection, erosion probability, organic matter contribution, and effects of use such as recreation, grazing, and mechanical activity will be made from this data.

Therefore, the question of whether moss covering a rock should be recorded as "moss" or "rock" is evaluated against the data objective. The result is to record cover as stone, boulder, etc. — whichever describes the soil surface and is what affects the above interpretations. In addition, moss that is growing directly on the soil surface should be recorded as "moss".

As a vegetative entity, the cover of moss should be captured by recording a bryophyte ("B") life form, "MOSS" species, and the appropriate percent cover. Do not record any moss cover more than once.

FORM DESCRIPTION
R2-2200-RN AND RN-2200-RNSUM

The Rooted Nested Frequency Data Form (R2-2200-RN) accommodates up to 70 items and 10 plot frames per transect. If there are more than 70 species on the transect, use additional field sheets as appropriate (that is, the data base can accommodate as many species as are present on up to 7 transects).

A summary data form (RN-2200-RNSum) is provided which is used for data entry (that is, information by species is entered by transect and not by individual plot frame).

SPATIAL IDENTIFIER (23-CHAR)

Enter the Spatial ID identified in field 1 of the General Field Data Form (R2-2200-GF).

Required *Accuracy Standard = No Errors*

FLORA IDENTIFICATION LEVEL (1-CHAR)

Identify whether all plants or only selected plant species, genera, or life forms encountered in plots are measured.

Required *Accuracy Standard = No Errors*

CODE	SPECIES IDENTIFICATION LEVEL
A	All plants encountered are being measured to species, genera, or life form
S	Selected species, genera, or life forms are being measured

NUMBER OF TRANSECTS (2-NUM, 2-NUM)

Identify which transect this form is by identifying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually five or seven. This number cannot exceed 10.

Required *Accuracy Standard = No Errors*

TRANSECT LENGTH (3-NUM, 2-CHAR)

Enter the total length of the transect and the unit of measure. For example, FT = feet and M = meter The standard length for the Rocky Mountain Region is 100 feet.

Required *Accuracy Standard = No Errors*

NUMBER OF FRAMES PER TRANSECT (2-NUM)

Enter the number of plot frames used to record rooted nested frequency along the transect. The standard number of plot frames for the Rocky Mountain Region is 10. More than 10 may be used if the variability if the site or other reasons warrant. No fewer than 10 plot frames will be established per transect.

Required *Accuracy Standard = No Errors*

ROOTED NESTED FREQUENCY RATIO (1-CHAR)

Four nested microplots will be used for rooted nested frequency assessment. The size ratio used in the Rocky Mountain Region is 100:50:25:1 (see Figure RN-3). Enter a "2" in this field to indicate that size ratio.

Required *Accuracy Standard = No Errors*

LIFE FORM (2-CHAR)

Use the following codes to describe the life form of each species.

Required ***Accuracy Standard = No Errors***
Source = CSDS: Life forms

CODE	LIFE FORM
T	tree
TR	woody tree
S	shrub
SH	woody shrub
SS	woody sub-shrub
ST	succulent
LI	woody liana
G	grass
GR	herbaceous graminoid
F	forb
FB	herbaceous forb/herb
VI	herbaceous vine
P	pteridophyte (fern and fern allies)
AL	algae
B	bryophyte (mosses and liverworts)
CL	crustose lichen
FO	foliose lichen
FR	fruiticose lichen
FU	fungus

NOTE: Whenever a plant species symbol is required, use the 8-character alpha-numeric codes from the Natural Resource Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.

ITEM NAME (8-CHAR)

The data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 75 entries per page. Use as many pages of R2-2200-RN as needed to record all items of interest in sampling.

Required
Accuracy Standard = No error in species level identification for dominant, common, or habitat type indicator plants

ROOTED NESTED FREQUENCY (1-NUM)

Indicate the smallest subplot each plant species is rooted in by recording rooted nested frequency for each plot frame using the following procedure:

1. Record "4" if the basal portion of a plant species is rooted in the smallest subplot.
2. Record "3" if the plant species is rooted in the next largest subplot ***and is not previously recorded in subplot 4***.
3. Record "2" if the plant species is rooted in the next largest subplot and is not previously recorded in subplots 3 or 4.
4. Record "1" if the plant species is rooted in the largest subplot and is not previously recorded in subplots 2, 3, or 4.

Individual plot frame rooted nested frequency values are not recorded in the data base. They are summed by transect for a given plant species and recorded in the sum of rooted frequency field.

Required, if rooted nested frequency is measured
Accuracy Standard = No Errors

SUM OF ROOTED FREQUENCY (SRF) (2-NUM)

Enter (by item) the sum of the rooted nested frequency values for the transect. This value is calculated by adding the subplot numbers recorded for a given plant species over all plot frames sampled within a transect. The maximum value for a plant species on a transect occurs when all the plot frames have the species in the smallest subplot (that is, summed value = 4 x number of microplots sampled).

Required, if rooted nested frequency is measured
Accuracy Standard = No Errors

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ROOTED NESTED FREQUENCY DATA
(R2-2200-RN)

SPATIAL ID: FS 02 12 10 373010830 0045 94
PURPOSE/PROJECT TABLE MESA / RED CREEK
PLANT ID C A
TRANSECT NUMBER: 1 of 5
TRANSECT LENGTH: 1 0 0
UNIT OF MEASURE: FT
FRAMES/TRANSECT: 1 0
ROOTED NESTED RATIO: 2

			Rooted Nested Frequency										
	LF	**Item**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**SRF**
1	S	ARTRV			2				1			4	7
2	S	SYOR2											
3	S	CHVI8		3									3
4	G	FETH	2	1			3			4		1	11
5	G	CAEL3		2		1	2		1		2		8
6	G	POPR	4	3	1	4	4	2	3	3		1	25
7	G	PONE2	2		1		3	4		2			12
8	G	KOMA	1			2			3				6
9	G	KOCR			3		1				2		6
10	G	BROMU						3					3
11	F	ACLA5	4		2	2	3		2	2	3	1	19
12	F	TAOF		2	2		2	2		1	3	4	16
13	F	PHMU3		4		4		2	2	3		1	16
14	F	MEFU2				1				1			2
15	F	LATHY						2					2
16	F	ERIOG						2					2
17	F	DEBA2									1		1
18	F	GASE6											
19	F	NOMO2			2			4					6
20													
21													
22													
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24													
25													
26													
27													
28													
29													
30													
Req	**Z**	**WOOD**											
Req	**Z**	**LITTER/DUFF**	2	1	4	2	1	2	4		1	2	19
Req	**Z**	**MOSS/LICHEN**				1							1
Req	**Z**	**BASAL VEG**	1					2			3	1	7
Req	**Z**	**WATER**											
Req	**Z**	**BARE SOIL <2mm**	1	3		1	2			4		1	12
Req	**Z**	**GRAVEL 2mm-3in**					1						1
Req	**Z**	**COBBLE 3-10in**											
Req	**Z**	**STONE 10-24in**											
Req	**Z**	**BOULDER >24in**											
Req	**Z**	**BEDROCK**											

ROOTED NESTED FREQUENCY DATA

SPATIAL ID: FS 02 12 10 373010830 0045 94

			Rooted Nested Frequency										
	LF	Item	1	2	3	4	5	6	7	8	9	10	SRF
31													
32													
33													
34													
35													
36													
37													
38													
39													
40													
41													
42													
43													
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75													

ROOTED NESTED FREQUENCY SUMMARY
(R2-2200-RNSum)

SPATIAL ID: FS 02 12 10 373010830 0045 94
PURPOSE/PROJECT TABLE MESA / RED CREEK
PLANT ID C A
TRANSECT NUMBER: 5
TRANSECT LENGTH: 1 0 0
UNIT OF MEASURE: FT
FRAMES/TRANSECT: 1 0
ROOTED NESTED RATIO: 2

			Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Transect 7
	LF	Item	SRF	SRF	SRF	SRF	SRF	SRF	SRF
1	S	ARTRV	7	10	5	4	12		
2	S	SYOR2		3		2			
3	S	CHVI8	3		2	6	8		
4	G	FETH	11	4	1				
5	G	CAEL3	8	2	3	14	6		
6	G	POPR	25	12	19	12	18		
7	G	PONE2	12	5	14	12	6		
8	G	KOMA	6		4		1		
9	G	KOCR	6		1	7			
10	G	BROMU	3	5	6	1			
11	F	ACLA5	19	24	16	26	14		
12	F	TAOF	16	8	12	20	18		
13	F	PHMU3	16	4	1		6		
14	F	MEFU2	2	1		2			
15	F	LATHY	2		1		5		
16	F	ERIOG	2			1			
17	F	DEBA2	1				4		
18	F	GASE6		4		3			
19	F	NOMO2	6				1		
20	F	ASDR3		1	1				
21	F	LUAR3		2	3	2			
22									
23									
24									
25									
26									
27									
28									
29									
30									
Rq	Z	WOOD							
Rq	Z	LITTER/DUFF	19	20	12	22	14		
Rq	Z	MOSS/LICHEN	1		3				
Rq	Z	BASAL VEG	7	10	5	4	8		
Rq	Z	WATER					2		
Rq	Z	BARE SOIL	12	10	16	14	14		
Rq	Z	GRAVEL	1				2		
Rq	Z	COBBLE			4				
Rq	Z	STONE							
Rq	Z	BOULDER							
Rq	Z	BEDROCK							

ROOTED NESTED FREQUENCY SUMMARY

SPATIAL ID: FS 02 12 10 373010830 0045 94

			Transcect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Transect 7
	LF	Item	SRF	SRF	SRF	SRF	SRF	SRF	SRF
31									
32									
33									
34									
35									
36									
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EXHIBIT SA: STREAMBANK ALTERATION
R2-2200-SA

GENERAL DISCUSSION

Measuring streambank alteration consists of walking the green line in a riparian area and determining the percentage of streambank altered by livestock during the current grazing season. The overriding concept behind the procedure is ensuring the continuum of streambank integrity. Most often, the best indicators of a reduction in bank integrity are livestock hoofprints, sloughing, and dislodged stones or longs along the bank/water interface. Physical alteration of the bank by trampling results in widening of the stream channel, and eventually leads to a loss of riparian function.

This method is to be used in conjunction with other short-term riparian monitoring methods, primarily stubble height (Exhibit SH) and woody browse utilization (Exhibit OE). This method should be taught to permittees so that the results can be used to determine when to move out of a pasture, before the riparian community is damaged. As a rule, streambanks can receive a maximum of 20-25 percent alteration annually[7] while continuing to maintain their health and integrity. It is extremely important to realize all riparian communities are unique and some stream systems are much more sensitive to alteration than others. For this reason, streambank alteration guidelines should only be used for annual management purposes and should not be used as strict requirements until such time as the guidelines have been verified to achieve a desired condition for a specific stream type and riparian community type under similar management strategies.

TRAINING

The Streambank Alteration Method does not require intensive training for field application. Examiners must be able to recognize trampling impacts from livestock and to record the number of paces of the livestock impact.

PERSONNEL AND EQUIPMENT

One person can complete and record streambank alteration transects, however it is easier and more efficient for a second person to function as a recorder. Equipment required is a hand-held computer, camera, and tally sheet.

SAMPLING PROCEDURE

Locate streambank alteration transects in key areas. Sampling should be done along a 100-foot paced transect on each side of the stream. Stubble height and woody species utilization measurement can, and should be, taken along the same transect.

The examiner should begin on the right-hand side of the stream, facing upstream. As the examiner paces, tally the number of paces where streambank alteration occurs due to livestock. At the completion of the transect, divide the paces of alteration 200 (total paces in the transect) to get the percentage of streambank alteration. For example:

$$\frac{\text{45 paces of alteration}}{\text{200 paces}} = 23\% \text{ streambank alteration}$$

---

[7] Presuming the annual alteration recovers during non-use. Cumulative alteration of 20 percent each year for multiple years is clearly unacceptable if resource recovery does not occur.

DETERMINE ALTERATION

The effect of hoofprints on bank integrity will always be a judgment call on the part of the surveyor. Some things to look for are: Is bare soil exposed to running water as a result of hoofprint action? Have the roots of bank stabilizing vegetation been exposed to air or water? Has the bank moved away from the center of the stream? Are hoofprints continuous or isolated? Is pioneering vegetation along the water's edge on gravel bars being trampled enough to allow displacement of bar material? Do pedestals exist along the streambank?

Bank alteration can be counted to 12-18 inches back from the bank, if it would eventually lead to the entire section falling into the stream during peak flow. Vertical cut banks, where there is no evidence of hoofprints along the top of the bank are not counted as altered.

Streambanks with a high percentage of bedrock, large boulders, and grapefruit-size cobbles are poor candidates for this method.

PHOTOGRAPHS

A series of photographs should be taken of the streambank alteration transect. The first photograph should be at the starting point, looking upstream. Additional photographs can be taken along the transect as desired.

STREAMBANK ALTERATION (R2-2200-SA)

FOREST BIGHORN NF	**DISTRICT** BUFFALO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER TABLE MOUNTAIN		**PASTURE** PAT PARK
KIND/CLASS & NUMBER OF ANIMALS 825 C/C	**PERIOD OF USE** 6/1 - 7/15	**ACTUAL USE** 1238 **Animal Months**
DATE 07/21/94	**EXAMINER(S)** J.DAWKINS	

	T1	T2	T3	T4
Total Alteration (paces)	45	67	14	28
Total Transect Length (paces)	200	200	200	200
Percent of Alteration	23	34	7	17

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EXHIBIT SD: SHRUB DENSITY AND AGE/FORM CLASS

R2-2200-SD

GENERAL DISCUSSION

Shrub density data can be used to supplement data collected with other trend monitoring methods, or be used by itself depending on the monitoring goals and objectives. It should not be employed as the sole basis for determining trend but may be used with or in lieu of the line intercept procedure. The technique provides plant (shrub) species density along with information on the form and age class of the various shrubs present. This information provides additional data for evaluating condition or trend in the shrub community, and is especially important where some form of cultural treatment has been done and/or where the shrub component is important.

SAMPLING PROCEDURE

Measurements for this procedure can be taken in conjunction with other trend transects. Measurements are taken along the whole 100-foot transect creating a sample area 100 feet long and 3 feet wide. A similar type study area can be independently set up if measurements are not made in conjunction with frequency belts.

All shrubs (or measured plants) encountered along the transect are dot tallied by species and classified according to form and age class. The Line Intercept Data Form (R2-2200-LI) is used to record this information. See Exhibit LI for a more detailed description of this method.

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EXHIBIT PU: PRODUCTION-UTILIZATION SURVEY

R2-2200-PU

GENERAL DISCUSSION

Production-utilization surveys require the completion of these steps:

1. Estimate production and utilization within a pasture or allotment. Delineate patterns or use zones on a map. Record average utilization (expressed as a percentage of current growth), and production (in pounds of forage per acre) for each use zone. Of the several methods of estimating production and utilization, ocular estimates verified through clipping and weighing is generally the most practical (see Exhibit US).

   Utilization estimates should be taken soon after livestock are removed from the area. For multi-pasture allotments the observer will need to make measurements after livestock are removed from each pasture. Acres should be calculated for each use zone and recorded.

2. Allowable use estimates should be made for each use zone identified. Express allowable use as a percentage of current year's growth. It is determined primarily from allowable use guidelines documented in the Forest Plan or AMP. Allowable use varies between use zones based on: location of the zone (riparian *vs.* upland site), time of use (early *vs.* late use pasture), management system in place, and distance from water. Allowable use should also be based on past distribution of grazing use.

   For example, an allowable use of 45 percent should not be established for a use zone when past utilization measurements indicate that the zone rarely is utilized more than 15 percent. If improved management could increase use in a particular zone, the allowable use estimate should reflect this expected increased use.

3. Transfer the recorded information to the allotment map (Figure PU–1) as follows:

   $$\frac{\textbf{\% actual use -- lbs. production /acre -- \% allowable use}}{\textbf{acres in use zone}}$$

   Figure PU-1 shows an example of a completed use zone map with recorded information.

4. Complete the Production-Utilization Summary Form (R2-2200-PUSum) for each pasture or unit. This involves calculating the actual area use factor and the allowable area use factor:

   acres x actual use % = actual area use factor

   acres x allowable use % = allowable use factor

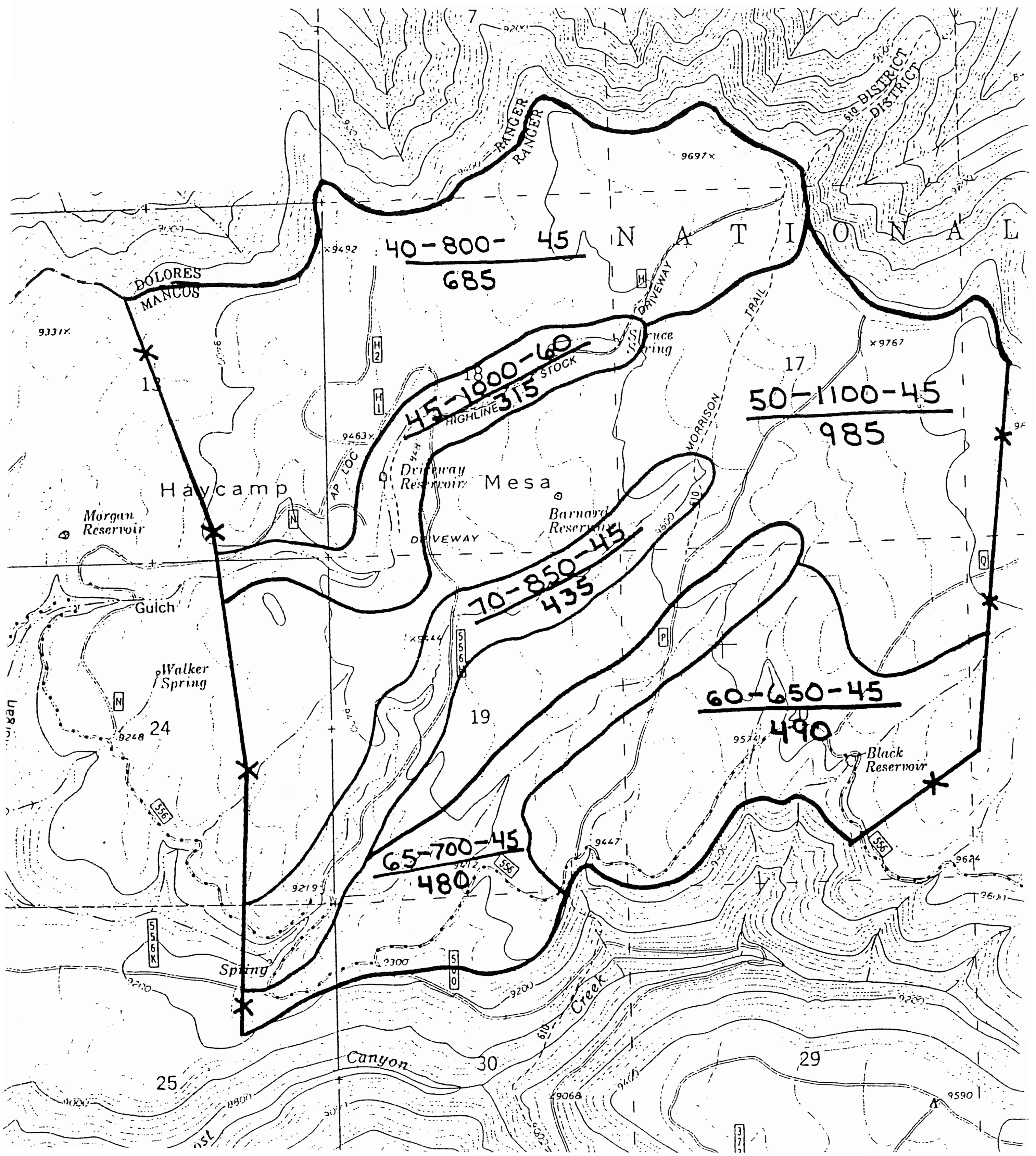
   An estimate of grazing capacity should also be made using the following formula:

   $$\frac{\textbf{annual area use factor}}{\textbf{AMs actual use}} = \frac{\textbf{allowable area use factor}}{x}$$

5. Prepare a narrative for each year of the study and at the conclusion of the study. Narratives should include: actual use data, a description of the study process, methods used to collect data, weather information, general observations, conclusions/recommendations, and the forms and maps. Permittees should be included in the study and updated on each year's results. The narrative is vital in helping the permittee and decision-maker understand how the data can be used in estimating grazing capacity and altering management strategies.

A study of this type could easily be adjusted to incorporate the use of residue methods in lieu of utilization methods.

Figure PU-1. USE ZONE MAP


40-800-45
685
45-1000-60
315
50-1100-45
985
70-850-45
435
60-650-45
490
65-700-45
480
DOLORES
MANCOS
RANGER
DISTRICT
N A T I O N A L
Haycamp Mesa
Driveway Reservoir
Barnard Reservoir
Morgan Reservoir
Spruce Spring
HIGHLINE STOCK DRIVEWAY
MORRISON TRAIL
Gulch
Walker Spring
Black Reservoir
Spring
Canyon
Creek
7
13
17
18
19
24
25
29
30
9697
9492
9331
9767
9463
9248
9219
9447
9068
9590

PRODUCTION UTILIZATION SUMMARY (R2-2200-PUSum)

FOREST BIGHORN NF	**DISTRICT** BUFFALO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER TABLE MOUNTAIN		**PASTURE** PAT PARK
KIND/CLASS & NUMBER OF ANIMALS 825 C/C	**PERIOD OF USE** 6/1 - 7/15	**ACTUAL USE** 1238 **Animal Months**
DATE 07/21/94	**EXAMINER(S)** J.DAWKINS	

$$\frac{\text{Annual Area Use Factor}}{\text{AMs Actual Use}} = \frac{\text{Allowable Area Use Factor}}{x}$$

Acres	Actual % Use	Annual Area Use Factor	Allowable % Use	Allowable Area Use Factor	Remarks
685	40	27,400	45	30,825	
315	45	14,175	60	18,900	
985	50	49,250	45	44,325	
435	70	30,450	45	19,575	
480	65	31,200	45	21,600	
490	60	29,400	45	22,050	
3,390		181,875		157,275	**Totals (or Subtotals)**

For example:

$$\frac{181875}{1238} = \frac{157275}{x}$$

$$181875x = 157275 \times 1238$$

$$x = 1071 \text{ AMs Desired}$$

1238 AMs Used
- 1071 AMs Desired
167 AMs Over - obligated

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EXHIBIT PG: PELLET GROUP COUNTS

R2-2200-CF

GENERAL DISCUSSION

Competition for forage between wildlife and livestock has become increasingly controversial in recent years. This guide contains several methods for estimating total forage utilization, but these methods do not determine the degree of use by wildlife versus livestock. Pellet group counts enable a rangeland manager to determine the relative use of an area by wildlife. This method is not intended to provide statistical estimates of wildlife populations, but rather to confirm or dismiss allegations of conflicts between wildlife and livestock.

This method should be used when forage utilization (grasses and shrubs) is at or exceeds allowable use guidelines and there is a question about whether wildlife is a substantial contributor to overuse.

TRAINING

This method is easily learned by completing one or two transects in the field.

PERSONNEL AND EQUIPMENT

Reading a wildlife pellet group transect requires two individuals, a tape measure or other device to measure 11.7 feet, a tally counter, a stake or screwdriver, and a pellet group form (R2-2200-PG).

SAMPLING PROCEDURE

Pellet groups are counted within ten 1/100th acre plots along predetermined paced transects. One transect with 10 plots may be sufficient if pellet groups are distributed uniformly throughout the area. More likely, 2-4 transects will be needed to adequately sample the variation in the quantity and distribution of pellet groups.

About every 20-25 paces along the transect, drive the stake with the tape attached into the ground near your toe. Measure 11.7 feet and begin walking in a circle with the tape stretched. One person should keep the tape stretched as the other counts the number of pellet groups (for the species selected) within the circle. Once all pellet groups within the circle are counted, record the total groups on the form and moved to the next plot location along the transect.

To be counted as a group, there must be a minimum of 15 pellets. In addition, at least half of the pellets must be within the plot to be counted as group. In high use areas, pellet groups are close together and the observer must take special care not to lump groups together. Past research on this method indicates that reliable population estimates can be obtained if the observers are careful, not missing or duplicating groups with the plot.

Since each plot is 1/100th acre, the ten plots together total 1/10th acre. Total days of use for each species is ascertained by first multiplying the total number of pellet groups on the transect by ten. The result is pellet groups per acre. Divide the number of pellet groups per acre by 13 for elk and deer. This approximates the number of days of use per acre for these species.

Recent experience in the Rocky Mountain Region suggests a rule-of-thumb, that wildlife/livestock conflicts tend to occur when the elk use days per acre exceed 15. Similar to livestock use, elk use impact on the resources depends primarily upon site specific conditions, season of use, length of use, and many other factors.

PELLET GROUP COUNTS (R2-2200-PG)

FOREST BIGHORN NF	**DISTRICT** BUFFALO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER TABLE MOUNTAIN	**PASTURE** PAT PARK	
KIND/CLASS & NUMBER OF ANIMALS 825 C/C	**PERIOD OF USE** 6/1 - 7/15	**ACTUAL USE** 1238 **Animal Months**
DATE 07/21/94	**EXAMINER(S)** J.DAWKINS	

Plot	T1	T2	T3	T4
1	3	5	2	8
2	1	4	7	5
3	5	0	1	3
4	8	8	6	5
5	1	4	5	1
6	6	3	5	3
7	4	1	4	3
8	9	8	9	7
9	2	5	8	0
10	0	4	2	4
Total groups per transect	39	42	49	39
Groups per acre	390	420	490	390
Wildlife use days per acre	30	32	38	30

EXHIBIT GRI: GRAZING RESPONSE INDEX

R2-2200-GRI

GENERAL DISCUSSION

The Grazing Response Index (GRI) is used to assess the effects of annual grazing pressures, and the effects of repetitive defoliation during the growing season. Understanding plant physiology and plant response to grazing is essential in the development of allotment management plans. Consequently, there is a need for a monitoring tool which adequately estimates rangeland use due to grazing. The tool must not only assess how much of the plant was grazed, but also when the plant was grazed and how many times it was defoliated during the growing season. GRI can be an effective tool to assess grazing systems or complications associated with situations such as early season big game use followed by livestock use.

The Grazing Response Index was developed to assess effects of use during the current year, and to aid in planning the grazing pattern for the following year. Consequently, GRI is based on general determinations of annual grazing use. GRI is not intended to be the only method for resolving major conflicts. *It should be used for situations where resource issues are considered low to mid level intensity, similar to the guidelines in Table 3-1.*

GRI considers three key concepts related to plant health: frequency, intensity, and opportunity.

FREQUENCY

Frequency is the number of times forage plants are defoliated during the (actual or planned) grazing period. It is dependent on the length of time plants are exposed to the grazing animals. Approximately 7-10 days is required for a plant to grow enough to be grazed again during late spring or early summer when plants are experiencing rapid growth. Local knowledge of the area is needed to determine how fast the plants are growing.

To obtain an estimate of how many times plants were (or will be) defoliated during a grazing period, divide the number of planned grazing days by 7 (or up to 10 if growth is slower). Using 7 is more conservative, because it will give the highest probable number of times the plants could be grazed. An index value of **+1 to -1** is assigned to as follows:

Number of Defoliations	Value
1	+1
2	0
3 or more	-1

INTENSITY

Intensity of defoliation is the amount of leaf material removed during the grazing period. The primary concern is *the amount of photosynthetically active leaf material remaining for the plant to recover from grazing.* This is not an estimate of percent utilization; generally, less than 40 percent defoliation will not inhibit plant growth. It is related to stocking rate. Intensity is described using three general levels of use.

Amount of Use	Percent	Value
Light	< 40%	+1
Moderate	40-55%	0
Heavy	> 55%	-1

The discussion on Ocular Estimates, specifically the herbaceous utilization classes (Table OE-1 on page 4-40), may be of assistance in assigning intensity values.

OPPORTUNITY

Opportunity is the amount of time plants have to grow prior to grazing or regrow after grazing. This factor is related to time of use. Opportunity is the one factor most highly related to long term health and vigor of the vegetation. It dependent on soil moisture, temperature, and leaf area. This factor is very important for sustaining healthy plants, thus the relative rankings for this attribute are doubled.

The index values for opportunity to grow or regrow forage are as follows:

Opportunity to Grow or Regrow	Value
Full season	+2
Most of season	+1
Some chance	0
Little chance	-1
No chance	-2

Determining opportunity is a judgment call based on appearance of vegetation at the end of the growing season. If the plants look like they were not grazed or just barely used, then a value of +2 is appropriate. If the plants look like they were used, but regrew fairly well, then use +1. Obviously, if the area has the appearance of being heavily used with no regrowth, assign a -2 value.

Even though opportunity is based upon appearance of the vegetation at the end of the growing season, there are some general guidelines that can help you make the determination. For example a pasture or allotment that is used season long can be expected to rate -2 (no chance). An allotment with 2 pastures will likely be in the 0 (some chance) or -1 (no chance) range. Allotments with multiple pastures that are used or rested at different times each year will usually receive the higher ratings of +2 or +1. These guidelines can help you get started, but the final rating should be based upon the appearance of the vegetation.

OVERALL RATING

The values for frequency, intensity, and opportunity are additive. The overall rating of the *expected response to grazing* is the sum of all three values. This result is a numerical value that is either positive, neutral, or negative. The index is a simple method to evaluate whether the grazing system has long term beneficial, neutral, or harmful effects to the rangeland forage. GRI gives a more comprehensive basis to plan future use that will maintain or improve plant health, structure, and vigor.

This index is based on grazing use that occurs during the growing season. This only marginally applies to grazing use when plants are dormant. Dormant season usually occurs after plants have had full opportunity to grow prior to use, hence an opportunity value of +2. Also, intensity is not as critical a parameter during the dormant season, because we are not concerned with producing regrowth.

TRAINING

The GRI method does not require intensive training. Examiners can develop their eye for estimating light, moderate, or heavy use. This coupled with practical observations of timing and time of use will provide the information needed.

PERSONNEL AND EQUIPMENT

With a small amount of training, an individual can assess the amount of use and correlate that use to both time and timing of the grazing period. Form R2-2200-GRI is used to record data for each area of interest.

SAMPLING PROCEDURE

Areas important to observe are: representative, special (critical or key areas), or treatment areas. The examiner should be familiar with the presence of these areas in the allotment or pasture to be rated. Also, it is important to have an idea of whether only one primary plant species, a group of species, or all forage plants in the area are to be monitored. The examiner should spend enough time to become familiar with grazing use patterns and levels of use across the area being rated. Rate the characteristics, record their ranking on the GRI form, and sum the rankings to obtain the GRI Index.

GRAZING RESPONSE INDEX (R2-2200-GRI)

FOREST BIGHORN NF	**DISTRICT** BUFFALO RD	**SPATIAL ID** FS 02 12 10 373010830 0045 94
ALLOTMENT NAME AND NUMBER TABLE MOUNTAIN		**PASTURE** PAT PARK
KIND/CLASS & NUMBER OF ANIMALS 825 C/C	**PERIOD OF USE** 6/1 - 7/15	**ACTUAL USE** 1238 **Animal Months**
DATE 07/21/94	**EXAMINER(S)** J.DAWKINS	

Number of Defoliations	Value
1	+1
2	0
3 or more	-1

Amount of Use	Percent	Value
Light	< 40%	+1
Moderate	40-55%	0
Heavy	> 55%	-1

Opportunity to Grow or Regrow	Value
Full season	+2
Most of season	+1
Some chance	0
Little chance	-1
No chance	-2

Pasture	Frequency	Intensity	Opportunity	Total GRI
1	+1	-1	+1	+1
2	0	0	-1	-1
3	0	0	+1	+1
4	-1	-1	-2	-4
5	+1	0	+2	+3
6	0	0	+1	+1
7	+1	+1	-1	+1
8	-1	0	-1	-2
9	0	+1	0	+1
10	0	-1	+1	0

REFERENCES:

Caldwell, M. M. 1984. Plant requirements for prudent grazing. From: Developing strategies for rangeland management. Westview Press, Boulder CO. pp 117-152

Richards, J. H.; Caldwell, M. M. 1985. Soluble carbohydrates, concurrent photosynthesis and deficiencies in regrowth following defoliation: a field study with *Agropyron* species. Journal of Applied Ecology 22:907-920.

Pond, F. W. 1960. Vigor of Idaho fescue in relation to different grazing intensities. Journal of Range Management 13:28-30.

Mueggler, W. F. 1972. Influence of competition on the response of bluebunch wheatgrass to clipping. Journal of Range Management 25:88-92.

RIPARIAN ECOSYSTEMS

WHAT IS RIPARIAN?

A watershed, or landscape, perspective is essential to sound management of intertwined and co-located natural resources. In the past, rigid use of riparian definitions has often reduced effectiveness of on-the-ground resource management. *It is more important to apply sound ecological principles to resource management than to debate riparian definitions and the specific location of a riparian area boundary.*

SOIL MOISTURE

Moisture availability is the single most important factor with respect to riparian versus non-riparian ecosystems. A soil is *saturated* when all pores are filled with water. Gravitational drainage empties the larger pores in the first step of the drying process. Soil moisture is now at *field capacity*, and all remaining water is held in tension by soil particles. Soil moisture is available for uptake by plants from field capacity to *permanent wilting point*, after which remaining water is held so tightly that plants cannot extract it.

Prolonged saturation promotes anaerobic conditions, which in turn affect soil characteristics and vegetation composition and abundance. Soil water between saturation and field capacity is free or unbound. Given the above, wetlands require prolonged saturation, while riparian ecosystems only require free or unbound water for some period of time.

RIPARIAN ECOSYSTEMS

In riparian ecosystems, free or unbound water may be ephemeral. In extreme situations, it may not even occur annually. The important *concept* is that riparian ecosystems differ from adjacent, terrestrial (upland) ecosystems because they require wetter soil moisture regimes that include at least periodic free or unbound water. This difference is typically displayed and confirmed by changes in vegetation composition and abundance, as well as physical soil properties.

Some suggest specific soil classification taxa be used to delineate riparian areas, for example, aquic soils. Such rigid criteria may apply fairly well in humid climates, but are improper in subhumid, semiarid, and arid climates where flora and fauna depend on riparian habitats that are not extremely moist.

In any climate, the scientifically sound definition of riparian ecosystem is the moist transition zone between the aquatic ecosystem and the relatively drier, more upland, terrestrial ecosystem(s). This transition zone can extend both laterally and longitudinally away from aquatic ecosystems, sometimes into headwater swales that have no defined stream channel. The riparian ecosystem is the area whose soil is relatively more moist than the adjacent upland and whose vegetation growth reflects the greater accumulation of available water.

It is the higher relative moisture that distinguishes riparian ecosystems from drier uplands. Low-lying areas supporting woody vegetation, commonly called *woody draws* in the Great Plains, exemplify this.[1] Wet soils occur infrequently, usually in the spring, and maybe not every spring. However, the soil moisture regimes required by woody draws sharply distinguishes them from adjacent, drier terrestrial ecosystems. Therefore, it is reasonable to conclude that such woody draws adjacent to aquatic ecosystems are themselves riparian ecosystems.

RIPARIAN ECOSYSTEMS VS. WETLANDS

The defining criteria for riparian ecosystems are that they are adjacent to aquatic ecosystems (laterally or longitudinally) and are relatively more moist than adjacent uplands. Riparian ecosystems occupy distinctive landforms in valley bottom settings. Free or unbound water may occur in uplands, but is more common in riparian settings. Adjacent aquatic ecosystems may be perennial, intermittent, or ephemeral, as may the free or unbound water in riparian ecosystems.

The defining criteria for riparian ecosystems and wetlands differ. *Wetlands* are not necessarily tied to aquatic ecosystems, but require saturated or seasonally-saturated soils along with obligate biota. *Riparian ecosystems* can occur only adjacent to aquatic ecosystems, but require free or unbound water that is drier than saturated. Many wetlands occur within riparian ecosystems, but those associated with unconnected seeps and springs in uplands do not. Many riparian ecosystems are not wet enough to be wetlands.

NEED FOR SOUND JUDGMENT

The clarifying concepts presented here are guidelines for identifying riparian ecosystems. In the natural world, it is not possible to create clear, succinct definitions that can be applied without using judgment in all cases. There is simply too much variation in nature to be explained by a set of written rules. All we can do is observe, and attempt to clarify and classify based on our understanding and experiences.

If this clarification does not fit well for a specific scenario, take a step back and apply the principles expressed in a professional, logical manner. It is important to continually evaluate riparian delineations against the objective for the delineation. Common sense must be applied, along with the principles presented here, to properly identify riparian areas.

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[1] There is a great deal of debate as to whether woody draws are, or are not, riparian. The debate varies as one moves from the Great Plains to the mountains, and continues with respect to low relief topography, particularly in National Grasslands, that are conduits of water flow only during precipitation events. While there is political and bureaucratic fallout determined by how many acres of riparian and miles of streams are identified on the landscape and by where these ecosystems occur, the most significant bottom line is responsible, effective management of all ecosystems. Regardless of whether a specific acre is labeled 'riparian' or a specific ephemeral segment is identified as a stream, it is paramount that ecosystems be managed for the specific characteristics and resource value ratings present.

COMPLEX CHARACTERIZATION

Riparian areas are typically composed of a mixture of different communities. For example, one or more willow, cinquefoil, Kentucky bluegrass, sedge, and sandbar communities may occur in repeating patterns within a specific riparian area. There are often four to as many as ten different community types within a riparian complex. Their distribution is dependent on the inherent dynamic nature of riparian ecosystems. Variation in community types is also dependent on various disturbance types such as fire, flood, grazing use, recreational activities, or road construction. It is normally valuable to describe a riparian area in terms of the relative distribution of the various plant communities present.

PLANT COMMUNITY IDENTIFICATION

Classification of riparian ecosystems is slowly improving within the Rocky Mountain Region (Girard et al., 1995). Most of the credit is due to the Colorado and Wyoming Natural Heritage Programs associated with The Nature Conservancy. Their work is often cooperatively sponsored by federal and state agencies and is conducted across a large array of land ownership's. Several final and draft products are available, and should be applied within the appropriate geographic areas (Jones and Walford, 1995; Kettler and McMullen, 1996; Kittel and Lederer, 1993; Kittel et al., 1994; Sanderson and Kettler n.d.).

Community type classification publications developed by the Intermountain Region may also be used as references for seral and potential natural communities (Padgett et al., 1989; Youngblood et al., 1985). Riparian communities in the Intermountain and Rocky Mountain regions appear to be very similar, perhaps as much as 80 overlap.[2] The overlap is obviously more significant near the boundary between these regions.

Resources are also available from other adjacent states; notably is the recent publication addressing riparian in Montana (Hansen et al., 1995).

Use Johnston (1987) either as a cross-reference with the Intermountain Region publications or as a supplemental source for identification of riparian communities that perhaps do not occur in the Intermountain Region or are not yet described in this Region.

The Bureau of Land Management published a review of riparian classifications (Gebhardt et al., 1990), which is useful for local application, and for gaining an understanding of what is available.

QUALITATIVE ASSESSMENT

Qualitative watershed assessment is done where more information is needed than an office-based assessment can provide. Field walk-throughs of key riparian areas are used to assess riparian and watershed conditions. Such broad qualitative surveys are needed in most watersheds, especially those requiring capital investments for restoration (**Class III**, see Table 5-1).

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[2] Al Winward, Riparian Ecologist, Intermountain Region; personal communications

WATERSHED CONDITION

The **PFC** (Proper Functioning Condition) survey (BLM, 1993, 1994) is the main assessment tool (Exhibit PFC). This is an ocular survey. Measurements are rare. Riparian Characteristics Evaluation sheets may be used to supplement PFC (Exhibit RC).

Focus this survey on key areas associated with 3rd-order and larger streams or perennial streams and lakes. Survey each riparian segment and valley segment separately to filter out natural variation. Conduct an interdisciplinary PFC survey using hydrology, aquatic and terrestrial ecology, and soils expertise, if at all possible. Follow procedures specified in BLM Technical Reports 1737-9 and 1737-11, "Process for Assessing Proper Functioning Condition." Map each surveyed segment as Properly Functioning, At Risk, or Not Functioning.

If all segments are rated as Properly Functioning, the watershed may be in **Class I** condition (Table 5-1). But, it may not! The PFC method does not consider all factors of stream, soil, or riparian health. If your careful professional judgment is that the full physical, chemical, and biological integrity of both aquatic and riparian ecosystems in all segments are good, then rate the watershed in **Class I** condition. If not, rate the watershed in **Class II** condition pending additional investigation.

If any segment is rated At Risk, the watershed is in **Class II** condition, at best. But if your careful professional judgment is that the physical, chemical, or biological integrity of either the aquatic or riparian ecosystems in any segment are poor, or that trends are declining, then rate the watershed in **Class III** condition.

If any segment is rated Not Functioning, then the watershed is positively in **Class III** condition.

WATERSHED SCREENING

Identify those watersheds for which this qualitative assessment is sufficient. This usually will apply only to watersheds with any segment rated as **Class I** (Properly Functioning) or **Class III** (Not Functioning) (Table 5-1). In your professional judgment, you are quite sure that more detailed data would not change the watershed condition class. Evaluate watersheds that need more detailed information in a quantitative assessment (see below).

Table 5-1. WATERSHED CONDITION CLASSES (Forest Service, 1994, Guldin, 1989)

CLASS	CONDITION	NARRATIVE
I	REGIMEN ATTAINMENT	The watershed provides a robust basis for sustained production of goods and services. No long-term changes result even from major storms. Risks of human-caused deterioration are very low. The watershed is in an attainable, desirable condition. It is in dynamic equilibrium as shown by a stable stream network.
II	SPECIAL EMPHASIS	The watershed does not meet Class I criteria but does not need capital investments to restore Class I conditions. The watershed may be sensitive to disturbance due to fragile streams and soils or may not yet have reached a dynamic equilibrium in recovering from past damage. Class I condition can be restored using an integrated, ecological approach to management.
III	INVESTMENT EMPHASIS	The watershed requires capital investments to restore Class II conditions. Revised management programs in addition to land and maybe structural treatments are needed to restore dynamic equilibrium.

QUANTITATIVE ASSESSMENT

Quantitative watershed assessment is done where more information is needed than the qualitative assessment can provide. This may apply if: (1) resource conflicts or sharp controversies exist, or may develop; (2) stream, soil, and vegetation types are complex; (3) present status and trend are unknown; or (4) more precision is needed. In general, a more complex management situation suggests a greater need for more detailed data. Conduct quantitative assessments as projects are scheduled in candidate watersheds.

Assess watershed condition by surveying streams, soils, and riparian areas that are sensitive to and impacted by disturbance. These are key areas whose vegetation, ground cover, and soil characteristics are likely degraded. They are also streams that adjust readily to changes in watershed or riparian condition. If the system is degraded, these streams should show it. If watershed condition is trending downward, the streams may not yet show degradation but key area soils and riparian vegetation will.

WATERSHED CONDITION

Make rapid field measures of stream, soil, and riparian health.[3] Compare key areas with reference conditions using a set of field metrics. Least-impacted streams, soils, and riparian areas in the same physiographic area are reference sites from which changes are measured. Compare streams, soils, and riparian areas of the same type in order to filter out natural variation and focus on management effects. Use the definitions in Table 5-1.

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[3] Sample protocols for stream and soil health metrics are being developed; they will be available Fall, 1996. Inclusion of the metrics here at this time is informational and educational.

STREAM HEALTH metrics assess the ability of aquatic habitat to support stable, diverse, and productive aquatic ecosystems. Apply the metrics to a 200-meter stream reach. This menu of seven metrics is sufficient to assess stream health in most cases. Select from this menu based on watershed features and impacts.

- **Cumulative widths and depths** are altered by flow or sediment changes and bank damage. Make 50 rapid measures of bankfull width and depth at regular intervals through the stream reach.
- **Large woody debris** modifies channel structure and creates pool habitats. Debris-related pools are tallied.
- **Substrate** is impacted by sediment deposition or stream manipulation. Tarzwell substrate ratio, percent sand infill, and pebble counts are related to aquatic ecosystem productivity.[4]
- **Bank stability** is expressed in four classes (vegetated stable/unstable, unvegetated stable/unstable).[5] Vegetated banks are unstable if they have tension fractures at the top. Unvegetated banks are unstable if they are composed of cobbles and/or finer particles.
- **Flow regime** is most often altered by drying up base flows or by extending or eliminating high flows through dams and diversions. Such altered flow regimes impair habitat capability.
- **Riffle insects** are impacted by chemical pollution from mine drainage in particular. Mayflies, stoneflies, and caddisflies are tallied on stream bed cobbles to show if a major physical or chemical impact exists.
- **Water chemistry** reflects stresses on aquatic biota. Summer maximum temperatures and dissolved oxygen are degraded by shade removal and altered channel shape. Alkalinity, pH, and conductivity are changed mostly by chemical pollution from mine drainage in particular.

SOIL HEALTH metrics address the physical and chemical quality of the soil. The focus is on long-term soil productivity of upland and riparian soils.

- **Detrimental compaction** is caused by excess weight of vehicles and animals on the ground. It impairs infiltration and root growth. Detrimental soil compaction is shown by a hummocky surface or increased bulk density.

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[4] This metric is included on the Green Line Vegetation Composition form (R2-2200-GL)

[5] This metric is included on the Green Line Vegetation Composition form (R2-2200-GL)

- **Detrimental displacement** is the removal of soil from an area, usually by machine piling. Displacement removes organic matter and nutrients.
- **Detrimental erosion** is caused by exposing and disturbing the surface soil. It is indicated by pedestals and rills on the soil surface.
- **Soil heating** is caused by severe fires that occur when humus and large fuels are dry and fuels are concentrated near the ground. Severe burning is indicated by a change in soil color and structure.

RIPARIAN VEGETATION HEALTH metrics address plant composition and structure. Riparian ecosystem complexity requires two-dimensional characterization.

The first dimension characterizes community attributes, or within-community variability. Methods used at this dimension include Ocular Plant Composition (Exhibit OP), Cover-Frequency (Exhibit CF), and Line Intercept (Exhibit LI). These standard methods describe the vegetation composition and ground cover for a site and can be summarized and extrapolated to represent the community.

The second dimension characterizes between-community variability of a riparian complex. The standard methods used at this dimension focus on the complex composition and the relative abundance of each community.

- **Cross-Section Composition** quantifies the distribution of riparian communities from the upland communities on one side of the stream, through the stream, to the upland communities on the other side. This is important because not all riparian communities occur at the water's edge.
- **Green Line Vegetation** quantifies distribution of riparian ecosystems along the green line, that is the perennial vegetation nearest to the water's edge. This is important because riparian communities along the green line are the most critical in maintaining healthy hydrologic function.
- **Woody Species Regeneration** is important in monitoring the trend of the riparian area.

APPLICATION

Class I watersheds are maintained in dynamic equilibrium by using preventive Watershed Conservation Practices (Forest Service, 1995b). There are 17 standards and 72 design criteria in five topic areas: hydrologic function; riparian areas and wetlands; erosion and sediment; soil productivity; and water purity.

Class II watersheds can be restored to **Class I** condition by slowing the rate or changing the nature of management actions. In many cases, restoration can be realized simply by applying watershed conservation practices more rigorously. Some streams, upland soils, and riparian areas may need restoration, but a major investment in watershed improvements is not needed.

Class III watersheds can be restored only if management is limited to actions that complement watershed recovery, and if watershed improvements are applied. Use watershed assessment results to make a watershed improvement needs (WIN) inventory and develop a whole-watershed improvement program. Treatments should address problem causes, complement hydrologic processes, favor vegetation instead of structural measures, and be designed for minimum maintenance. These actions enhance long-term effectiveness and economy of improvements.

THE LOCAL UNIT SCALE: SITE-SPECIFIC EFFECTS

Assessments at this scale focus on implementation and effectiveness of conservation measures where discrete activities, streams, soils, and riparian areas are monitored. Methods used are often the same as those described for the quantitative watershed condition assessment. Additional methods may be required, depending on the intensity and statistical defensibility required. Keep in mind the following key items for both short- and long-term monitoring:

- establishment and survival of deep-rooted shrubs and herbaceous species,
- stream bank stability,
- soil compaction and erosion,
- browsing levels on brush species,
- utilization of herbaceous species, and
- level of controversy and resource use conflicts.

Data are used to diagnose the health of specific streams, soils, and riparian ecosystems. The basic monitoring approach is outlined below. The focus is on application of conservation measures, monitoring of their implementation and effectiveness, and a feedback mechanism to adjust management.

1. Apply specific Watershed Conservation Practices (WCPs) to management activities on Forest Service and BLM lands (Forest Service, 1995b). Implement these WCPs to sustain long-term stream, soil, and riparian health.
2. Monitor WCP implementation to ensure that WCPs are applied as designed, and WCP effectiveness to ensure that stream, soil, and riparian health are protected. Emphasis is on monitoring representative conditions and actions where the information gained is most likely to improve the degree of protection provided over a large geographic area. Document the results of all such monitoring.
    - Monitoring of WCP implementation will primarily occur as recorded visual certification that WCPs have been applied as prescribed.

- Monitoring of WCP effectiveness will include recorded visual surveys and recorded measures of various streams, soils, and riparian vegetation parameters. Compare measures with reference sites in the same physiographic setting. The parameters measured will depend on the type of monitoring (short-term, long-term) being done.

SHORT-TERM MONITORING

Short-term monitoring checks project compliance with management requirements and mitigation measures. It is also used to validate and implement resource management prescriptions, such as an allotment management plan. Monitoring intensity should conform to the degree of resource conflict or controversy in the area. The of time and effort devoted to monitoring is the discretion of the unit manager. Compliance monitoring often focuses on factors such as rills and compaction, sediment deposition, and stream bank alteration.

It is recommended for normal grazing administration in riparian areas, the following be used as general guidelines for short-term monitoring.

- Assess stream bank alteration and move livestock before unacceptable levels of stream bank trampling occurs. The Stream Bank Alteration monitoring method is described in Exhibit SA of the Monitoring Chapter. Recent experience in southwestern Montana suggests that damage to stream banks begins to reach problem levels as forage becomes short (Beaverhead National Forest, 1993). Therefore it is imperative that stubble height standards be closely followed. The amount of trampling allowed must be adjusted by stream type and the desired condition. Refer to standards and guidelines from the Forest Plan for more information.
- Use stubble height and regrowth standards from the Intermountain Region (Clary and Webster, 1989). Once livestock exceeds allowable use levels on herbaceous plants, they begin to browse shrubs and walk up and down the riparian corridor. This is when soil compaction, stream bank trampling, and shrub hedging begin to exceed acceptable levels.
- Observe hedging on shrubs and use the general browse utilization guide (page 4-39). Light to moderate use during dormancy usually does not adversely affect shrubs. Be aware of the correlation between forage use levels, time of use, and the resultant use on shrubs if livestock are left in a riparian area too long.

LONG-TERM MONITORING

Long-term monitoring is a periodic checkup of resource status and trend. It is often used in the reassessment of watershed condition. Trend is determined using the same factors described for watershed condition assessment, level 3. Begin with cover-frequency and/or line intercept inventory methods. Use the cross-section composition, green line transect, and woody species regeneration sampling methods as needed, particularly to detect changes in relative plant composition distribution. Repeated application of these techniques to determine vegetation characteristics for a complex provides the basis for assessing trends in riparian area vegetation condition through time.

APPLICATION

Use monitoring results as a feedback mechanism to modify management activities, adjust WCPs, or update watershed condition assessments and watershed improvement needs inventories as needed. Watershed condition trend should be determined by monitoring treated sites, and project implementation monitoring should focus on prescription effectiveness and compliance issues.

- If monitoring identifies a problem created by an activity such that stream, soil, or riparian health are not protected, the activity will be stopped or modified; mitigation measures that remedy the problem will be promptly installed. Contracts and project plans will be modified to ensure that these added measures are implemented as prescribed, and monitoring will continue to ensure that the measures are effective.
- If monitoring finds WCPs to be inadequate to protect stream, soil, or riparian health, they will be adjusted to provide adequate protection.
- If monitoring finds that stream, soil, and riparian health have changed enough to move watershed condition into another class, the prior watershed condition assessment will be updated to reflect the new information.

EXHIBIT PFC: PROPER FUNCTIONING CONDITION

GENERAL DISCUSSION

The Proper Functioning Condition survey was developed by the Bureau of Land Management. A complete description of the use of this survey is found in their technical reference publications (Bureau of Land Management, 1993 and 1994).

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Proper Functioning Condition
Standard Checklist

NAME OF RIPARIAN-WETLAND AREA: ______________________________

DATE: ____________ **SEGMENT/REACH ID:** ____________________ **MILES:** ____________

ID TEAM OBSERVERS: ______________________________

YES	NO	N/A	HYDROLOGIC
			1) Floodplain inundated in "relatively frequent" events (1-3 years)
			2) Active/stable beaver dams
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
			4) Riparian zone is widening or has achieved potential extent
			5) Upland watershed not contributing to riparian degradation

YES	NO	N/A	VEGETATIVE
			6) Diverse age structure of vegetation (recruitment for maintenance/recovery)
			7) Diverse composition of vegetation (for maintenance recovery)
			8) Species present indicate maintenance of riparian soil moisture characteristics
			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
			10) Riparian plants exhibit high vigor
			11) Adequate vegetative cover present to protect banks and dissipate energy during high flows
			12) Plant communities in the riparian area an adequate source of coarse and/or large woody debris

YES	NO	N/A	EROSION DEPOSITION
			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody debris) adequate to dissipate energy
			14) Point bars are revegetating
			15) Lateral stream movement is associated with natural sinuosity
			16) System is vertically stable
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

(Revised 1995)

Remarks

____
____
____
____
____
____
____
____
____
____

Summary Determination

FUNCTIONAL RATING:

PROPER FUNCTIONING CONDITION: __________
FUNCTIONAL -- AT RISK: __________
NONFUNCTIONAL: __________
UNKNOWN: __________

TREND FOR FUNCTIONAL -- AT RISK

UPWARD: __________
DOWNWARD: __________
NOT APPARENT: __________

ARE FACTORS CONTRIBUTING TO UNACCEPTABLE CONDITIONS OUTSIDE BLM'S CONTROL OR MANAGEMENT?

YES: __________
NO: __________

IF YES, WHAT ARE THOSE FACTORS?

_____ FLOW REGULATIONS
_____ CHANNELIZATION
_____ AUGMENTED FLOWS
_____ MINING ACTIVITIES
_____ ROAD ENCROACHMENT
_____ OTHER (SPECIFY) ________________________________
_____ UPSTREAM CHANNEL CONDITIONS
_____ OIL FIELD WATER DISCHARGE

EXHIBIT CS: CROSS-SECTION COMPOSITION

R2-2200-CS

GENERAL DISCUSSION

The Cross-Section Composition Method is used to describe and quantify the distribution of riparian communities within the riparian area. This information is important because:

- the distribution of individual plant communities within a riparian ecosystem is often very dynamic, and
- not all riparian communities occur at the water's edge.

This method is used for both inventory and monitoring purposes.

TRAINING

The Cross-Section Composition Method does not require intensive training for field application. Both small and large riparian areas can be sampled quickly. Examiners must be able to recognize different communities and identify where the change between communities occurs. The most complicated aspect of this method is to record the number of feet per community for all communities on each cross-section.

PERSONNEL AND EQUIPMENT

One person can complete and record cross-section composition transects, however it is easier and more efficient for a second person to function as a recorder. The equipment required to complete this method are stakes to mark the transect ends, a hand-held counter, and a camera.

SAMPLING PROCEDURE

At least five paced transects are established perpendicular to the riparian complex in such a way as to cross the entire riparian area (Figure 5-1). More transects should be established if the riparian area is too large for five transects to describe, or if variability warrants. Start at the lower end of the riparian area with the first cross-section composition transect and work your way up stream.

Beginning and ending points for each transect are permanently marked with stakes. The permanent stakes should be placed far enough back into the non-riparian area to allow subsequent measurements in case the riparian area expands. ***Note that in this method the examiner is measuring the intercept of plant communities, not individual plant species.***

Community type composition is obtained by tallying the number of feet encountered for each type in relation to the number of total number of feet used in all transects. A hand held counter will aid in this sampling process. Note, since different individuals have distinct step lengths each person should test themselves with a measured transect so that steps can be converted to feet. Use the Cross-Section Composition Form (R2-2200-CS) to record the number of steps for each transect and the Cross-Section Composition Summary Form (R2-2200-CSSum) to summarize the community distribution for the entire riparian area.

More precise quantification of ground cover may be preferred by hydrologists. Implement and use those measurements as available and necessary.

PHOTOGRAPHS

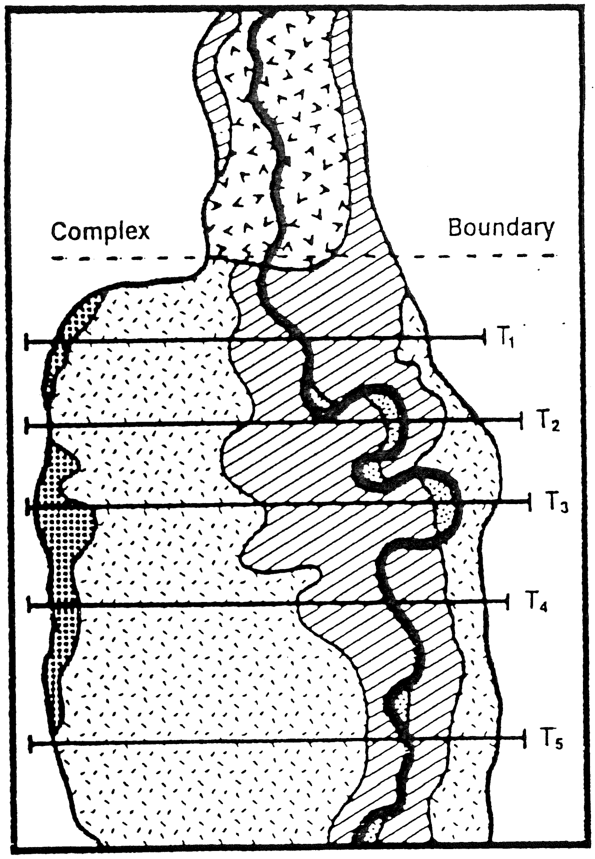
Photographs will be taken at each of the starting points. The objective of the photographs is to depict the setting of the cross-section. Photographs are also taken at the location(s) where the cross-section crosses the stream channel. Additional photos may be taken from the ending point as well. Be sure to include permanent landscape features wherever possible to assist in geo-referencing the transects.

EXAMPLE

Percent composition for each community type is calculated on the Cross Section Summary Form (R2-2200-CSSum) and is illustrated on the sample form. Composition of the Kentucky bluegrass (POPR) community type is 56 percent (280 feet/500 feet). Similarly the composition of the redtop (AGST2) community type is 6 percent. Composition for all community types encountered in the complex should total 100 percent.

Figure 5-1. VEGETATION COMPOSITION WITHIN A COMPLEX

Use the cross-section composition method to measure community type composition. Subsequent measurements measure and document amount of change in relative abundance of each community type.



		T_1	T_2	T_3	T_4	T_5	% Comp.
Alder/ Dogwood	⊠						
Willow/ Beaked Sedge	▨	40	45	35	25	20	(33)
Kentucky Bluegrass	⬚	50	45	45	60	80	(56)
Redtop	▒		10	5	15		(6)
Oatgrass	▦	10	T	15			(5)

Percent Disturbed = 62

CROSS-SECTION SUMMARY
(R2-2200-CSSum)

FOREST WHITE RIVER NF	**DISTRICT** HOLY CROSS RD	**DATE COMPILED** 08/12/94
DRAINAGE ELK CREEK	**PURPOSE**	**PROJECT**
EXAMINER(S) B. SAGE		**PHOTO NUMBER(S)** 4-9
COMPLEX		
TRANSECT NO.		

Community Type	**T_1 (feet)**	**T_2 (feet)**	**T_3 (feet)**	**T_4 (feet)**	**T_5 (feet)**	**TOTAL (feet)**	**Percent Composition** **Total Riparian**
Transect Length	100	100	100	100	100	500	
POPR	50	45	45	60	80	280	56
SALIX/CAUT	40	45	35	25	20	165	33
DAIN	10	T	15			25	5
AGST2		10	5	15		30	6
					GRAND TOTAL	500	100%

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EXHIBIT GL: GREEN LINE VEGETATION COMPOSITION

R2-2200-GL

GENERAL DISCUSSION

Sampling community type composition along edges of live water can provide additional information over that collected by the cross-section process. Presence of permanent water in the plant rooting zone allows more rapid recovery of vegetation after disturbances. This permits a rangeland manager to make an earlier evaluation of management intended to improve riparian condition. Also, measurement of this portion of the riparian area provides an indication of short-term trend for the riparian area. This is where the forces of water, as influenced by total watershed condition, play their most prominent role.

Additionally, there is a strong relationship between amount and kind of vegetation along the water's edge and bank stability. Natural plant species in this permanently watered area have developed rooting systems that enhance bank stability. An evaluation of the vegetation in this area can thus provide a good indication of the general health of the watershed, as well as the stream..

The green line is defined as that specific area where a more or less continuous cover of perennial, hydric vegetation is encountered when moving away from the perennial water source (Figure 5-2).

At times, the green line may be at the water's edge. Or, it may be part way back on a gravel or sandbar. The green line may be only a foot or two wide, or may be many feet wide, depending on soil and water features. Native plant species forming the green line, such as beaked sedge or water sedge are generally good buffers of water forces. Disturbance activities, such as overgrazing or trampling by animals or people, result in changes to species such as Kentucky bluegrass or redtop, both of which have a reduced ability to buffer water forces.

In most riparian settings, there is a continual effort by nature to form this green line of vegetation, even where the adjacent community types are composed of the more shallow-rooted species. Well-developed green line vegetation stabilizes channel banks and buffers water forces. This enhances channel stability, even for inherently unstable stream types. Therefore, an evaluation of the community type composition of the green line can provide a good indication of the general health of the riparian area.

TRAINING

The Green Line Vegetation Composition Method does not require intensive training for field application. Examiners must be able to recognize different communities and identify where the change between communities occurs. The most complicated aspect of this method is to record the number of feet per community for all communities on each cross-section.

Examiners should work closely with District or Forest hydrologists or fisheries biologists to learn to estimate percent composition of different stream substrates. In addition, examiners must be able to recognize characteristics of stable and unstable stream banks.

PERSONNEL AND EQUIPMENT

One person can complete and record green line vegetation composition transects, however it is easier and more efficient for a second person to function as a recorder. The equipment required to complete this method are stakes to mark transect ends, a hand-held counter, and a camera.

SAMPLING PROCEDURE

The green line transect begins on the right-hand side of the stream (looking upstream) at the point where the first cross-section composition transect intercepts the green line (Figure 5-2). In settings where the stream has multiple channels, use the current, most dominant channel. Sampling proceeds up the green line using a paced transect, as described in the cross-section composition measurement, instead of a stretched tape.

Enough steps should be taken to total 363 feet linear distance; the number of steps will vary from examiner to examiner. A temporary marker is placed at the end of the transect for location of subsequent shrub measurements. The examiner then crosses the stream and repeats the sampling process for 363 feet downstream. Use the Riparian Green Line Transect Data Form (R2-2200-GL) to record the number of steps for each transect and the Green Line Summary (R2-2200-GLSum) to summarize the community distribution for the entire riparian area.

Start and stop counts are recorded for every community type change. Subsequent measurements of the same area provide a measurement of trend for that complex. Indicating start and stop counts on the form will assist in evaluating trend later. In addition, they are important cross references with aquatic surveys.

NOTE: The stopping point may not coincide with the initial starting point due to differences in lengths of meanders on each side of the stream. It is important to sample both sides of the stream since activities (grazing pressures or water forces) may be different on each side.

On certain streams, especially those with steep gradients, the number of feet of large anchored rocks or large logs should be tallied in addition to the vegetation. Rocks and logs must be large enough to withstand the forces of water and must appear stable in the setting being measured. The number of feet of rocks and logs would be counted as a natural stable percentage of the green line. Also tally the number of feet of disturbed or damaged stream bank. This gives an accurate measure of the amount of disturbance.

Experience has shown that stream bank stability is a critical characteristic for initial inventory and monitoring of grazing programs. Stream substrates are also important from fisheries and stream health perspectives. Fill out estimates of stream bank stability and stream substrates when doing the green line transect. For more quantifiable information on stream bank stability, complete the stream bank alteration method described in Exhibit SA.

NUMBER OF TRANSECTS

The number of green line transects measured is dependent on inventory intensity, and the complexity and size of the riparian ecosystem. As many as one green line transect may be established for each cross-section composition transect. At least one green line transect should be established for every grouping of cross-section composition transects.

COMPUTATIONS

The total amount of each community type encountered along the green line is tallied and composition for each type computed as described in the cross-section composition measurement. For example:

$$\frac{\text{total feet of each type (left + right side)}}{\text{726 ft. (363 ft. minimum each side)}} = \text{CT composition}$$

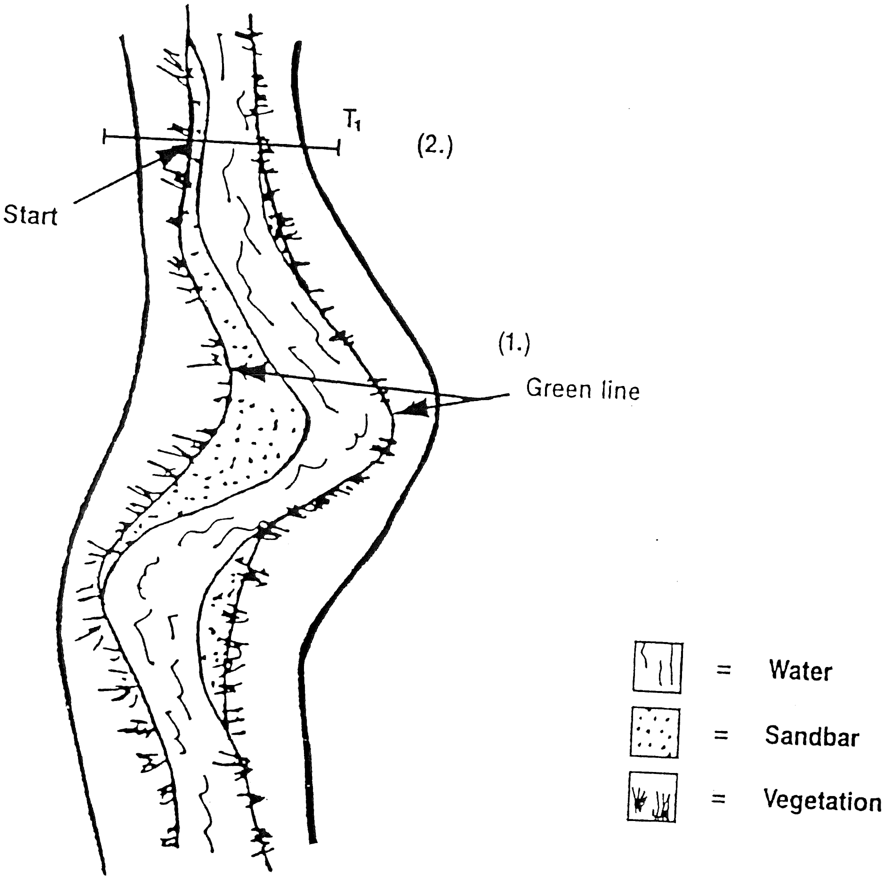
PHOTOGRAPHS

A photograph can be taken at the starting point of the green line transect, looking upstream. Additional photos may be taken along the transect if desired. These photographs should include permanent landscape features wherever possible to assist in geo-referencing the transects so they can be reestablished in the future.

Conduct a woody species regeneration survey on the same transect location using Form R2-2200-WS (page 5-23).

Figure 5-2. GREEN LINE VEGETATION COMPOSITION MEASUREMENT

Location of (1) the green line in relation to the water's edge and to sandbars and (2) location of the green line transect in relation to the cross-section composition transect.


T1
(2.)
Start
(1.)
Green line
= Water
= Sandbar
= Vegetation

GREEN LINE SUMMARY (R2-2200-GLSum)

FOREST WHITE RIVER NF	DISTRICT HOLY CROSS RD	DATE COMPILED 08/12/94
DRAINAGE ELK CREEK	PURPOSE	PROJECT
EXAMINER(S) B. SAGE		PHOTO NUMBER(S) 4-9
COMPLEX		
TRANSECT NO.		

Community Type	T_1 (feet)	T_2 (feet)	T_3 (feet)	T_4 (feet)	T_5 (feet)	COMPOSITION Total Feet	COMPOSITION Percent
SALIX/CAUT	327	301	319	298	284	1529	84%
AGST2	36	44	29	65	54	228	13%
POPR		18	15		25	58	3%

STREAM SUBSTRATE	PERCENT	BANK STABILITY (estimate to nearest 10 percent)	PERCENT
Sand/Silt/Clay (<2 mm)	45%	**Vegetated-Stable**: bank is vegetated with no evidence of active erosion or sloughing and no tension fractures.	60%
Gravel (2-63 mm)	35%	**Vegetated-Unstable**: bank is vegetated, but tension fractures exist at the top of the bank.	20%
Cobble-Boulder (>63 mm)	15%	**Unvegetated-Stable**: Bank is not vegetated, but is composed of bedrock or stable boulders or cobbles.	15%
Bedrock	5%	**Unvegetated-Unstable**: Bank is not vegetated and is composed of bare gravel, sand, silt, or clay, or a matrix of cobbles and these finer particles.	5%

EXHIBIT WS: WOODY SPECIES REGENERATION
R2-2200-WS

GENERAL DISCUSSION

Not all riparian areas are well suited for growing woody species. This appears to be especially true where the complex has a low gradient and a limited amount of natural stream channel movement. In these settings, understory sedges and rushes are able to buffer the forces of water without the addition of woody species. Most of the woody riparian species in the Intermountain Region regenerate best in settings where there is minimal competition from herbaceous species.

TRAINING

The Woody Species Regeneration Method does not require intensive training for field application. Examiners must be able to recognize woody plants by species in varying forms of maturity and hedging. The most complicated aspect of this method is to record the number of feet along the green line per species for all woody species.

PERSONNEL AND EQUIPMENT

One person can complete and record woody species regeneration transects, however it is easier and more efficient for a second person to function as a recorder. The equipment required to complete this method are a 6-foot pole with the center marked, a hand-held counter, and a camera.

SAMPLING PROCEDURE

A measurement of woody species regeneration is made along the same paced line as is the green line transect (Figure 5-3). The examiner uses a 6-foot pole that has the center marked. Measurements are made by walking 363 feet on each side of the stream with the center of the pole held directly over the edge of the green line adjacent to the water body. Using the green line edge as the center of the measurement helps to assure that the sampling is done in a setting where regeneration is most likely to occur.

Modification of the above procedure may be necessary for narrow water bodies. In these settings do not allow the left tip of the pole to extend beyond the center of the water body. When that occurs, align the left tip of the pole on the center of the water body (the pole is no longer centered on the green line edge). This modification eliminates double sampling when measuring from both sides, yet insures that a full one-tenth acre area is sampled.

All woody species rooted within the ends of the pole (3 feet either side of the green line) are tallied based on the following age class categories.

	Number of Stems	Age Class
1	1	sprout
2	2 to 10	young
3	>10, >1/2 alive	early mature
4	>10, <1/2 alive	late mature
5	0 stems alive	dead or decadent

A tally of shrubs by age class provides a preliminary indication of regeneration of shrubs in that complex. A high proportion of plants recorded in the sprout, young, and early mature categories would indicate the shrub component in this complex is in an upward trend. Conversely, low numbers of plants in the sprout and young categories would indicate current management may be suppressing woody species.

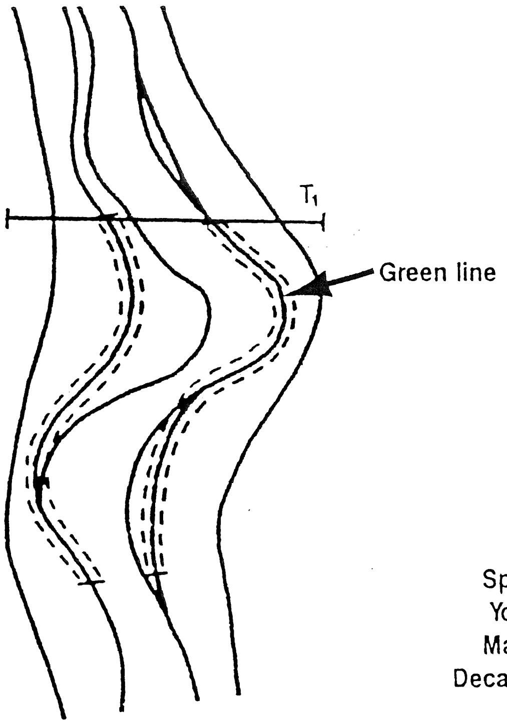
A comparison of settings where the complex is as close to PNC as possible may be used as a standard to evaluate overall shrub status. Subsequent measurements on the same area will provide a measurement of woody species regeneration trend. Use the Woody Species Regeneration Form (R2-2200-WS) to record the number of steps for each transect and the Woody Species Regeneration Summary Form (R2-2200-WSSum) to summarize the species distribution for the entire riparian area.

For smaller statured species such as *Salix wolfii*, change the number of stems upper limit from ten to five for the young, early mature, and late mature age classes. For single-stemmed species such as *Salix exigua*, *Betula* spp., and *Alnus* spp., count each stem that occurs 12 or more inches from another as a separate plant. Place these into age classes based on overall size and health.

Figure 5-3. SHRUB COUNTS (BY AGE CLASS)

Example of woody species status using a tally of individual plants, by age class, in a 6-foot wide belt along the green line. A belt 6 feet wide by 726 feet long equals 0.10 acre.

363 ft. each side (726' total)
3 ft. each side of green line =6 ft. wide belt
= 1 / 10 Acre



Example

Sprouts	3
Young	21
Mature	12
Decadent	10
Dead	2

= Healthy Reproduction

WOODY SPECIES REGENERATION SUMMARY
(R2-2200-WSSum)

FOREST WHITE RIVER NF	**DISTRICT** HOLY CROSS RD	**DATE COMPILED** 08/12/94
DRAINAGE ELK CREEK	**PURPOSE**	**PROJECT**
EXAMINER(S) B. SAGE		**PHOTO NUMBER(S)** 4-9
COMPLEX		
TRANSECT NO.		

Species	Seedling/Sprout			Young/Sapling			Mature			Decadent			Dead			Total
	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	
SAGE2	2	3	1	1			11	6	4		2		1		2	33
ALNUS	1		1		2		3	2	1	1		1		1		13
SABO2			1			2	8	2			1		1			15
TOTAL (each trans)	3	3	3	1	2	2	22	10	5	1	3	1	2	1	2	61
TOTAL (combined)	9			5			37			5			5			61

Statement of Health and General Comments:

AVERAGE HEIGHT:

Tree Layer(s)	16 FT
Shrub Layer(s)	10 FT
Herb Layer(s)	1 FT

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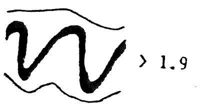
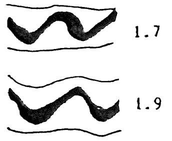
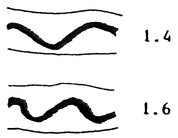
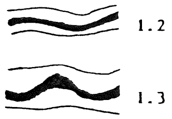
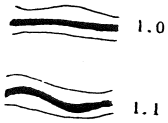
EXHIBIT RC: RIPARIAN CHARACTERISTICS EVALUATION

(R2-2200-RC)

RIPARIAN CHARACTERISTICS EVALUATION

Streams (Circle descriptions that fit best) (R2-2200-RCS)

Stream Bank Stability				
Stream bank damage <5%; no mass wasting; plants of high vigor and deep, binding root systems holding banks intact; no overflows beyond channel confines.	Stream bank damage 5-15% mainly at curves and constrictions; infrequent mass wasting; vigor moderately high; normally healthy root systems effectively hold bank in place; overflows beyond channel confines are rare.	Stream bank damage 16-30%; bank mass wasting occurring at critical locations, moderate plant vigor with root systems barely able to stabilize banks; channel at times inadequate for peak flows.	Stream bank damage 31-45%; discontinuous mass wasting, with little healing; low plant vigor and weak root systems allowing frequent bank breakdown; channel inadequate to hold peak flows.	Stream bank damage >45%; bank overhang failures frequent and year-long vegetation cover sparse with weak, shallow root systems, often exposed; channel inadequate for frequently occurring floods.
Meander				
				
Tree Overstory				
Stands mostly discontinuous; >40% canopy cover; 4+ size classes; deciduous trees dominant, occasional conifers, single species may dominate; light use; regeneration linear and vigorous.	Stands discontinuous; 25-40% canopy cover; 3-4 size classes; deciduous trees dominant, conifers infrequent; light to moderate use on regeneration.	Stand canopy 11-25%; interspaces partially filled with shrubs and grasses; 2-3 tree size classes present; exotics minor component; moderate use or damage; regeneration adequate to replenish stand.	Tree canopy 5-10%; 1-2 size classes, with only decadent stand common; heavy use; seedlings and sprouts sparse and heavily damaged; new stands not establishing; exotics invading.	Canopy <5%; trees very scattered or entirely lacking; very heavy use and damage; no regeneration of native trees; exotics often dominate
Shrub Midstory				
Shrub canopy >50%; 2+ palatable species present, but single genus, such as *Salix* may dominate; growth form linear; light browsing on most palatable species.	35-50% shrub canopy; variety of species, single palatable species dominance more common; growth form linear, with lateral branching from light browsing.	Canopy cover 21-35%; some weakened desirable species; intermediate species can dominate; lateral branching common from moderate use; regeneration limited.	Canopy cover 10-20%; single age classes and single species dominate; heavy browsing causing clubbed appearance; little to no reproduction of desirable species.	Canopy cover <10%; only unpalatable shrubs present in sizable numbers, or shrubs lacking; remnant desirable shrubs severely clubbed; no regeneration.
Understory				
Desirable grasses and sedges dominate; forbs limited to those which are highly palatable; >90% ground cover; plants vigorous with large seed heads; desirable seedlings or litter fill bare spaces; light use >5%.	Some intermediate plants, up to 25% in composition but dominated by desirables; perennial forbs a component of the understory; ground cover 80-89%; seed heads common; trampling minimal; light to moderate use.	Intermediate grasses and perennial forbs common; few least desirables; 65-79% ground cover; vigor down; some seed heads on less palatable grasses; soil trampling evident; use moderate to heavy.	Intermediate plants dominate with a few remnant weakened relic desirable plants, invader plants common; 50-64% ground cover; vigor down due to heavy current use; soil movement evident.	Intermediate and least desirable plants dominate; <50% ground cover; bare spaces increasing; very heavy current use; overland erosion and soil compaction rampant.

If damage is occurring what are the probable damaging agents:

____ None
____ Natural
____ Upstream building
____ Upstream or adjacent cultivation
____ Burning
____ Big game browsing and concentration

____ Livestock grazing
____ Tree or shrub removal
____ Beaver activities or dam failure
____ Channelization
____ Dredging
____ Mine tailings

____ Road building
____ People concentration and trampling
____ Dam breaching or failure
____ Excessive dewatering
____ Other ____________________

Relative community distribution, remarks, and recommendations: ____________________

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RIPARIAN CHARACTERISTICS EVALUATION SHEET
(R2-2200-RCL)

Lakes and Reservoirs (Circle descriptions that fit best)

Tree Overstory				
4-5 size classes present with willow or cottonwood dominant; discontinuous stands or clumps with >35% canopy coverage; sprouts and seedlings vigorous.	2-3 size classes present; frequently single species; trees in clusters with canopy cover 20-35%; at least half of regeneration surviving.	Commonly 1-2 size classes, mature and overmature; canopy cover 5-19%; browsing moderate resulting in suppressed regeneration; exotics may occur, but rare.	Native trees usually decadent; total tree canopy cover <5%; heavily browsed and inadequate sprouts or seedlings for regeneration; exotics common.	No native trees present, or if present very suppressed and severely browsed and damaged; exotics commonly dominant if trees exist.
Shrub Midstory				
Variety of age/size classes; however only a single willow species may occur; canopy cover >30%; little to no use, rubbing, or trampling.	Several age classes represented; willow monocultures common; canopy 15-30%; light use, rubbing, or trampling; mostly linear growth.	2-3 age/size classes; shrub canopy 5-14%; some dead wood in older plants from moderate browsing, rubbing, or trampling; exotics may occur.	Very few native shrubs that are severely clubbed; <5% canopy cover; exotics commonly dominate with heavy animal damage; few sprouts or seedlings; much dead wood in older shrubs.	No native shrubs present; the stand composed of heavily damaged exotics, or shrubs lacking; at least 5 years since impoundment built.
Understory				
A variety of plants present, mainly dominated by desirable grasses and sedges; a few forbs will occur; ground cover 95-100%; plants vigorous with many large seed heads; little to no use.	Desirable grasses and sedges dominant; intermediates and least desirables not over 1/3 the stand; ground cover 85-94%; vigor good and seed heads common; light use < 15%.	Intermediate plants common; annual forbs evident; some desirables remaining, but not over 30% of composition; ground cover 70-84%; few seed heads on more palatable plants; vigor fair; use 16-35%.	Intermediate plants dominant with least desirable forbs a conspicuous component; desirables stunted relics; ground cover 50-69%; seed heads on increasers; use 36-60%.	Annual least desirables dominant; intermediates of low vigor; no desirables; ground cover <50%; bare spots not filling as fast as occurring; heavy use >60%.
Shoreline				
<5% of shoreline and riparian zone trampled or otherwise disturbed; no evidence of silt or sand deposition at inlets; water can clear between storms.	5-15% annual disturbance; slight evidence of siltation and deposition; water a little cloudy after intense storms.	16-40% of shoreline and riparian annually trampled or disturbed; silt depositions and cloudy water common after storms.	41-60% annual disturbance; silt deposits and new bar buildup after most storms; water remaining cloudy for long periods after storms.	>60% annual disturbance; new silt deposits in all inlets after storms; water continually cloudy with suspended sediments.

If damage is occurring what are the probable damaging agents:

____ None
____ Natural
____ Upstream building
____ Upstream or adjacent cultivation
____ Burning
____ Big game browsing and concentration

____ Livestock grazing
____ Tree or shrub removal
____ Beaver activities or dam failure
____ Channelization
____ Dredging
____ Mine tailings

____ Road building
____ People concentration and trampling
____ Dam breaching or failure
____ Excessive dewatering
____ Other
____

Relative community distribution, remarks, and recommendations: ____

____

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RIPARIAN CHARACTERISTICS EVALUATION SHEET
(R2-2200-RCW)

Woody Draws (Circle descriptions that fit best)

Trees				
Canopy cover >10%; several native species; 3-5 size classes; light to no browsing or rubbing damage; regeneration common.	Canopy cover 5-10%; 2-3 size classes of indigenous trees; light to moderate damage from rubbing and browsing; adequate regeneration.	Canopy cover <5%; 1-2 size classes of native and exotic trees; heavy browsing and rubbing damage; sparse and barely adequate regeneration.	Trees rare, mainly decadent; very heavy damage; exotics may dominate; no regeneration.	No trees present.
Shrubs				
Variety of palatable shrubs; canopy cover > 50%; all size classes; linear growth; use and damage barely noticeable.	Desirable shrubs dominate with up to 25% of stand intermediates and least desirables; canopy cover 30-50%; linear growth common with light browsing and rubbing.	Desirable shrubs <15% of stand; intermediates dominant with up to 20% least desirables; canopy cover 10-29%; palatable shrubs heavily damaged from browsing and rubbing; few young plants.	Intermediate-least desirable shrubs over 75% of stand; desirables rare; canopy cover <10%; heavy damage on intermediates and desirables; no regeneration of palatable species.	Few to no intermediates or least desirables dominant, or shrubs lacking.
Understory				
Vigorous grass stand with a few desirable forbs; desirables over 75% of composition; ground cover >85%; mulch and duff layer under dense tree-shrub canopy.	Desirable-intermediate grass stand with occasional forbs; smaller and fewer seed heads; ground cover 75-85%; moderately vigorous; light duff cover under trees and shrubs.	Intermediates over 50%; desirables infrequent and weak; least desirables 10-20%; ground cover 60-74%; mulch and duff absent or trampled into soil; desirables not reproducing.	Intermediate-least desirable stand with desirables rare; forbs common; ground cover 40-59%; heavy annual use>60%; seedlings mainly least desirables.	Mostly forb least desirables over 50% of stand; intermediates weak and scattered; ground cover <40%; little or no seed production.
Soil and Water				
Little or no trampling or compaction; ground cover effective in preventing erosion; flooding infrequent and not detrimental; strong root systems holding soil in place.	Trampling resulting in compaction on 10-25% of area; plants and litter generally effective in preventing erosion, except in high intensity storms; root systems adequate.	Trampling and compaction on 26-50% of area; some soil movement from limited litter and plant cover; plant roots barely effective in halting erosion in downpour rains.	Trampling and compaction on 51-75% of area; overland water movement and erosion common even with moderate rains; debris lodging in shrubs; roots weak and ineffective in halting erosion.	Trampling and compaction on >75% of area; new silt and sand deposits common with each rain; root systems often exposed and ineffective in holding soil in place.

If damage is occurring what are the probable damaging agents:

____ None
____ Natural
____ Upstream building
____ Upstream or adjacent cultivation
____ Burning
____ Big game browsing and concentration
____ Livestock grazing
____ Tree or shrub removal
____ Beaver activities or dam failure
____ Channelization
____ Dredging
____ Mine tailings
____ Road building
____ People concentration and trampling
____ Dam breaching or failure
____ Excessive dewatering
____ Other
____

Relative community distribution, remarks, and recommendations: ________________

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